ORGANIZATION AND ADMINISTRATION OF INDUSTRY

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FOREWORD

An understanding of industrial economics is necessary to anyone who aspires to a responsible position in any sphere of modern industrial activity.

Industrial Administration now demands an extensive knowledge not only of internal organization, but also of all the external factors which influence the course of industry. British commerce no longer holds that dominant position in world trade which allowed it to expand almost of its own momentum during the latter half of the nineteenth century. Foreign competitors, fully equipped with modern machinery and advanced technical knowledge, are now in the field.

The maintenance of our export trade is, however, none the less essential to our national well-being, and this makes it indispensable that our present and future industrial leaders should command a range of knowledge which the men who gave England her industrial supremacy in the last century had not at that time developed, nor indeed was it then to the same degree imperative.

I am confident that this Introduction to Industrial Science, which Professor Lloyd-Dodd and Dr. Lynch have prepared, will provide the student with a valuable textbook on these important matters and the general reader with a wide survey of the industrial field.

J. Milne Barbour

Conway,
Dunmurry,
Co. Antrim

PREFACE

THIS book provides a complete introduction to Industrial Science. Such knowledge is now an essential qualification for those who are, or expect to be, employed in technical, managerial, or administrative capacities in industry and trade.

Under modern industrial conditions industrial prosperity depends not only upon volume of output but upon quality of output, and can only be built up and maintained through the thorough understanding of all factors in industrial efficiency in relation to current economic conditions. Thus, skill and knowledge, whether of the worker, of the manager, or of the inventor, are of little avail if the conditions for production are non-economic in the modern industrial sense.

The main principles underlying the functions of modern industry may be reduced in form to scientific laws. Industrial Science is now recognized by all industrial countries as being the important element in building up the efficiency and competitive power of industry and trade. British industrialists have not been slow to acknowledge and accept this fact. Many British universities now include Industrial Science as a Degree Course in their Faculties of Applied Science and Technology. Technical colleges provide, under the Commercial section, yet side by side with specialized technological instruction, courses in business organization, in administrative technique, and in the economic principles underlying industrial operations. The Institution of Mechanical Engineers demands as a condition for Associate-Membership a definite standard of knowledge in Industrial Administration.

The compilation of a book intended to cover the main principles of such a vast body of knowledge, as is implied

by the above varied examination syllabuses, must of necessity involve a certain amount of compression and the exclusion of certain points of detail. Where this has been necessary the authors have been careful to ensure that it does not detract from the utility of the book as a general exposition of the subject.

Industrial Science is in fact the outcome of hundreds of years of a gradually evolving method of the work of production. The present industrial structure is but another stage in this process of evolution. The necessary reference to the historical development of British industry has formed Part I of this book, which deals with the progress of industry through its different phases to the present-day form.

In Part II the aim has been to show the general relation between industry and the economic world as a whole, and to indicate broadly the general tendencies of the lines along which it is developing. The outstanding features in the structure and working of the modern capitalistic system of industry have been dealt with so as to link its historical development in Great Britain with its modern world-wide ramifications. At the same time many of the vital economic and social problems of the present day have been fully discussed.

Part III deals with the practical aspect of the administration of industry. Fundamentals of administration such as organization with its principles and functions, management with its dependence upon laws of Industrial Science, and production with its sensitivity to modern factors in industrial efficiency and to economic laws, have been treated comprehensively and in detail, and at the same time have been arranged to give the industrial student a bird's-eye view of the growing complexity and interconnections of modern industrial administration.

Consideration has been given to concrete problems, such as factory location and the planning and the lay-out of modern works; while in the more abstract problem of

labour efficiency, the book provides comparative discussions on different methods of remuneration in relation to the efficiency of labour; and also on the importance of the relations of technical education and industrial training to the needs of industry and trade.

While there are certain underlying principles of administration which hold good for all forms of industrial effort, the separation between the ownership of industrial capital and its administration demands the formulation of new administrative standards. Industry must learn the principles of self-government, and in the application of those principles it must not only recognize the just aspirations of labour but safeguard the interests of the consumer, otherwise it cannot hope to escape an ever-increasing interference by the State in industrial affairs.

The authors wish to express their indebtedness to the Council of the Institute of Bankers in Ireland for permission to make use of matter which has already appeared in the Journal of the Institute; to the Editor of the *Economist* for permission to reproduce the diagrams relating to the Oil and Chemical combines; and to the Publishers and the Institute of Industrial Psychology for permission to use certain diagrams from the book *Industrial Psychology in Practice*, by H. J. Welch and G. H. Miles, D.Sc. A list of books and other publications consulted appears in the Bibliography, and, where possible, an acknowledgment to individual authors is made in the footnotes. Special thanks are due to the late Dr. G. A. Tipping, B.Com., and to Mr. J. F. Hayes, M.Com.Sc., for assistance in the correction of the proofs and also to the former for much useful criticism of the matter in Part II.

F. T. LLOYD-DODD.
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PART I

CHAPTER I

THE CRAFT GUILDS

THE historical development of British industry falls into certain well-defined periods, each of which is marked by some dominant characteristic. There have been in the past four distinct phases: the period of household production, the handicraft period, the cottage period of domestic production, and the factory period. A new industrial age, becoming more clearly defined, is emerging from the transitional chaos of post-War industrialism and may be said to be but one more step in the process of evolution.

The gradually evolving method of the work of production, from the relatively unimportant period of household production to the highly-specialized industrialism of to-day, was profoundly disturbed and rapidly accelerated in the advent of the third phase which ushered in the technical age.

The technical age unfolded itself in two fundamentally different aspects: the one, experimental and empirical, the other, marked by its application of thorough knowledge, scientifically planned. Both aspects were constructive and acquisitive; both were materialistic in type. From them developed the embryo of the present phase which, though constructive and acquisitive, had a new science of administration and systematization, and contains

within its structure some provision for the ethical side of industry.

In the early stages of industry the inhabitants of the British Isles were very far behind the standard of manufacturing and productive achievements that then characterized other parts of the known world. They were slow to take up and develop what had been going on for centuries before in other lands; for instance, the roots of the engineering industry go back almost to prehistoric times, taking as evidence of this the Great Pyramid and the records of ingenious structures, mechanisms, and tools of forgotten Eastern civilizations. How well the principles of engineering science were applied is shown by constructional achievements like Solomon's Temple, Roman aqueducts and roads. "Both the Greeks and the Romans worked and used iron, and the principles underlying ancient tools did not differ from those of the present day. It may be said that to some race or another in the old days, every form of engineering was known except those requiring the application of generated forces."[1] This latter statement might, however, be extended to include mention of the fact that generated forces had been applied in very early ages to contrivances, which, although they held no practical form of utility, were nevertheless classical examples of scientific toys. Sir Alfred Ewing, writing of the early history of the steam engine,[2] draws attention to notices of heat engines found in the Pneumatics of Hero of Alexandria, which dates from the second century B.C. One contrivance mentioned is the aeolipile, a steam-reaction turbine. Another apparatus described was ingeniously used to open the heavy temple doors, and was in actual fact the prototype of a class of engine which long afterwards became practically important.

There was a long period of transition between the end of what is termed the first period of industry in Great Britain

[1] T. H. Burnham, *Engineering Economics*, p. 141.
[2] Sir Alfred Ewing, *The Steam Engine*, p. 2.

and definite signs of the beginning of the second. As communities of men grew in size and strangers from other countries invaded and settled down among the inhabitants of these islands, settlements or large-sized villages were formed, embryonic of the cities and towns which to-day stand upon those original sites. Within these communities agriculture took a predominant place, the inhabitants being obliged to cultivate the surrounding land and to pay dues to the Lord of the Manor. Craftmanship and commercial dealings, however, developed rapidly, and were carried on in the small towns more extensively than elsewhere. The precedence of agrarian interests over craftmanship persisted, even when trade and craft had become recognized as essential and useful callings.

The Guild Merchant

In the eleventh century, with the advent of the Normans, English towns grew rapidly in size and importance. Trade received fresh impetus, and not only did commercial intercourse flourish and was encouraged between town and town but merchants came from Europe and sold commodities which England could not otherwise have obtained. Towns became economic units in themselves, and in each the trade regulations differed and acted independently. There was, however, no hint of nationalization of trade taking place as long as the means of communication remained in a primitive state. Each town expected to be cut off during the winter months by the state of the roads. Hence no reliable system of communication permitted the cheap intercourse of goods.

Town economy represented the vital principle of medieval economic life. Every town strove to become self-dependent with active powers of aggression and defence. The independence of towns influenced the nature and scope of medieval society's economic activities to the extent that an exclusion of strangers, imposition of tolls, the

right of reprisals, the restriction of outside competition, isolated every locality from its neighbours. Within the impenetrable barriers of protective tariffs and stringent regulations a municipal policy constituted the mainspring of industrial and social development. Associations of traders guarded the mercantile privileges of each town and during the twelfth and thirteenth centuries the monopoly of trading had fallen into their hands. Each association was known as a merchant guild and became, during the growth of towns and expansion of trade which followed the Norman Conquest, the focusing point of the trading activities of each borough. The merchant guild, which had existed previously in France, Flanders, and Italy, only made its appearance in England after the Norman Settlement. The main object of the guilds was the increasing of trade facilities, but subsidiary aims were many and varied.

Royal charter, bestowed upon a guild at its foundation or conferred later, enhanced the status and power of the guild and was effective in compelling non-members to bow to all trade regulations and ordinances. Illegal transactions were prevented and members' commercial interests were safeguarded against the encroachment of outsiders. In the interests of general prosperity, non-guildsmen were allowed to trade, but their commercial dealings had to be with guildsmen only; they had to pay tax and confine their trade to such commodities not expressly forbidden by the guild.

In return for the privilege of membership the guildsman was bound to observe the regulations which the guild merchant from time to time imposed. The aims of the medieval legislator were permeated by conceptions of a "just price" that was fair to both producer and consumer. Buying goods before they reached the market to hold them back till their value had risen, or buying goods at cheaper rates than market prices, were practices which violated medieval ideas of commercial morality, and were highly

disapproved of by the guild. Also, the scrutiny of manufactured wares exposed for sale in the town was a function not lightly disregarded by the guild authorities. The control of a guild over industry, and its regulation of trade, were marked everywhere by extraordinary attention to the minutest details. Such vigilance on the part of a guild left little scope for great fluctuation in prices; breaches and evasions of ordinances and regulations were attended by condign penalties—fines and the pillory being the most usual form of punishment. The ordinances of the guild, although sometimes narrow in a sense which defeated the objects they had in view, were framed with the fundamental purpose of protecting the consumer as far as possible from greed and fraud of producers or dealers. Collision of interests frequently arose, but as the welfare of the community was of paramount importance to the medieval burghers they acted upon the assumption that the economic interests of the individual and of society are not necessarily and invariably the same, and they imposed restrictions which to the present century would seem futile.

The monopoly which the guild, by rules and regulations, asserted so jealously and guarded so rigorously was maintained only by ceaseless care. It resulted in the medieval town being simply an isolated economic unit in which the interests of strangers and the general control of economic life were deliberately subordinated to the well-being of the townsmen or guildsmen. An Englishman from a neighbouring town or a foreigner from the Continent were equally regarded as strangers, and therefore outside the privileged circle and subject to disabilities in commercial life.

The relations between different elements of the community within the towns had often periods of strain. In general, it was usually a case of friction between rich and poor, as there was little scope for industrial oppression. Medieval craftsmen were not involved in any struggle with the merchant classes—or at any rate there is no

evidence to be brought forward from the twelfth and thirteenth centuries to support this contention. Although in a wide sense the merchant guild was composed more of the landed citizens than of industrial workers in the early Middle Ages, landless craftsmen were freely admitted to membership, provided they paid dues and resigned all pretensions to control their trade. The word "merchant," however, is misleading in the sense that it suggests capital, but it must be interpreted as being applied to all who engaged in trade, which includes those master craftsmen who were both artisans and traders. Sometimes a master craftsman not only bought the raw material and manufactured his commodities and sold them, but employed several other craftsmen in his business.

The increase in trade brought a large share of wealth to many guildsmen, and the town looked to the wealthier members for support to meet the increasing monetary exactions of the Crown. The power of wealth tempted some of the brethren to give up craft and occupy themselves with trade alone and thus equip themselves more suitably for taking the chief offices in the guild or influential positions on the governing body of the town. The guild and the borough tended to coalesce and become identical in towns, where the chief offices in each were held by the same persons; and gradually the alliance between the two, originally distinct in origin, merged into the municipality.

A process of disintegration became apparent in the guild system as the merchant guild assumed complete identity with municipal control; as an organized municipal system they were necessarily drawn into conflict with all who were reluctant to be absorbed into the common life of the town or submit to the jurisdiction of the borough courts. The medieval view of industry and trade, in that the individual is subordinated to the interests of the community along with the claim to the right of monopolizing particular trades, brought the natural corollary that those who sought

to share immunities must first share burdens. The merchant guild never wished to exclude craftsmen, but craftsmen refused to be brought within the merchant guild, as guildship became not a privilege so much as a burden involving heavy responsibilities. Craftsmen tended gradually to show preference for holding their own courts, levying their own assessments, and standing completely outside the municipal governing body.

Alien craftsmen had come to England in great numbers during that period when Europe was industrially ahead of English towns, and much new material was being exported from England to France and Flanders for manufacture. These alien craftsmen had formed for themselves craft guilds independent of the guild merchant. As time passed, those native craftsmen who, less wealthy than their more mercantile-minded brethren, or trader artisans of the guild merchant, alleged that the cost of citizenship was unduly excessive, disassociated themselves from the guild merchant, and either joined an alien guild or formed craft guilds on that model.

There is evidence that the relationship between the guild merchant and the craft guilds was often strained, especially when the guild merchant had been merged into the municipality. The craft guilds were subordinate to the town, or to the guild merchant, where that still maintained a separate existence; but they gradually took over the regulation of industry and trade, and in the fourteenth and fifteenth centuries they had obtained full control. Though relations were strained between the municipality and the craft guilds, there is little evidence of economic oppression or of the craft guilds being involved in real struggles with the merchant classes. The craft guilds met with opposition at first from the guild merchant, and artisans were excluded from civic rights. The explanation commonly given is the alien origin of the craft guilds, as exemplified by the first formed guild of the weavers, but this does not seem sufficient in other cases. W. J. Ashley, in his *English Economic*

History, says "that the merchant guild could be regarded as being comprised of the landed citizens, and the craft guilds as comprised of the landless industrial workers who came into existence by the side of the original body of landed burgesses."[1]

The Craft Guilds

In 1300 the objection of the municipal authorities to the formation of craft guilds was apparently removed, and there followed a rapid development of craft guilds. They carried with them a degree of the authority of the guild merchant in regard to industrial control, and during the fourteenth century the guild merchant tended to disappear under the operation of this new economic force. Specialization in industry increased and was responsible for the process of disintegration, in that it was an economic cause which robbed the guild merchant of vitality.

The first craft guild was, as already stated, that of the weavers, established under Henry I among the weavers of London, Winchester, Oxford, Lincoln, and Huntingdon. The whole guild system broke down earlier in the weaving industry than in any other direction. It was the submission of the weavers' guilds to the town authorities in 1300 which ended a constitutional conflict and was responsible for the later fact of the guild merchant dying out from inanition. By the end of the thirteenth century craft guilds flourished in every town of note, and any individual who practised craft was expected to belong to one or other of them. The craft guilds were not now founded by the Crown, but by the municipality, and on this account were more amenable to municipal control. The craft guilds became public bodies carrying semi-legal authority, a department of civic administration with supervision of trade and industry delegated to them by the municipality, which, however, always retained a reserve of power over them.

[1] *Vide* E. Lipson, *Economic History of England.*

Every trade, art, and craft was represented by a guild—guilds of mariners, shipwrights, painters, masons, candle-makers, cappers, cardwire drawers, card makers, carpenters, dyers, fullers, drapers, girdlers, ironworkers, haberdashers, pewterers, smiths, tanners, shoemakers, goldsmiths, saddlers, tailors, tilers, chandlers, weavers, and so on. Victuallers had guilds—the bakers, cooks, grocers, vintners, brewers, butchers, and others. A notable exception, however, in the formation of guilds is found in the agricultural industry. In the country the feudal system of exchange by barter persisted; and it was only in towns, where coinage had been introduced at an early period, that regulation of trade was possible.

In the height of their greatness the guilds were a powerful economic and social force, organized and administered as they were on the same lines as the merchant guild. Their general aims and principles were also alike; and in those lies the fundamental interest of the medieval craft guild, since they represent a vital stage in economic evolution and enable us to visualize how industrial problems were handled and solved in the Middle Ages.

The craft guild comprised three classes of members—the masters, the journeymen, and the apprentices—and the general organization of it consisted of a head, usually an alderman of the town, with wardens to assist him, up to four in number; there was also a Council formed of masters and wardens with a dean and a clerk. The regulations were framed by the members themselves for the members, and the welfare of each was the concern of the whole body. Trade and craft and the keeping of a high moral standard among the guildsmen claimed first attention. In the control of industry financial interests played little part. Money was valued as a medium of exchange and not for accumulation. The wealth of a guild consisted usually of property or kind, and much care was given to the management of such resources as the guild possessed, and every legitimate means was taken to increase them. Regulations

were framed for the trade ideal of perfect work for a just price, and the keynote of most of a guild's rules was reflected in the standard set to ensure good quality of the work of its members. Charity and justice might be said to be the guiding principles of the guilds' rules and regulations.

The control of the craft guild lay in the hands of the assembly and the wardens, who held office by the year. The wardens were bound by oath to fulfil their obligations to the guild. They were forbidden to inflict excessive punishment, nor could they bribe or otherwise extort money for their own gain. Favouritism or personal spite—human failings on the part of many in control—could be discerned without much difficulty in those wardens who were not discreet and indifferent in fulfilling the obligations incumbent upon their office. Redress was obtained by an injured craftsman by appeal to the mayor or to a master, where the guild was governed by a master as well as by wardens. The guilds laid great emphasis upon the soundness of the machinery of workshop inspection for ensuring articles and utilities of the best quality of manufacture, and searches through the workshops took place twice a week in some crafts down to once a month in others. The wardens supervised the work of production of craftsmen, and any warden who failed in his duty, either in respect of workshop inspection or in respect of the standard of quality and workmanship of the goods he passed, was fined.

House-to-house visits were not so impracticable as it seems, for men of the same craft dwelt in the same street. Historical evidence remains in the names of present-day London streets and streets of other towns—Bowyers' Row, Tanners' Lane, Chandlers' Court, Glover Street, etc.

Apprenticeship

Medieval society could not conceive that a member of a craft guild was other than in possession of a well-founded

knowledge of his particular craft. The institution of apprenticeship, the most typical and instructive feature of the guild system, developed in order that the tradition of good work might never be allowed to lapse. Its exact beginning is uncertain, but it was strongly in existence and widely recognized in the thirteenth century. The object of apprenticeship is set out in an Elizabethan state document: "until a man grow unto the age of twenty-three years" . . . he has not . . . "grown unto the full knowledge of the art that he professed." Apprenticeship implied a system of technical and social training by which the craftsman was initiated into the secrets of his craft and rendered qualified to carry on his calling.[1]

A craftsman received a young boy whom he instructed in every part of his craft. The boy was regarded, during his apprenticeship, as a member of the craftsman's family. During the period of training, which usually lasted for seven or eight years, the master was held responsible for the boy's moral behaviour as well as for the success he achieved in workmanship. For instance: In Dublin it was by law established that each master had to answer for his apprentice's bad conduct, day or night, as he would for any of his own offspring. The apprenticeship was a contract between the boy's parents or guardians and the master, which usually took the form of an indenture, properly signed and sealed, in which the master bound himself to teach the boy his craft and to pay him a small wage in return for an annual fee paid either in money or kind by the boy's parents. A master was limited to two apprentices at a time. The usual limitation was one, with a proviso that a second apprentice could be indentured when the first was nearing the completion of his time of training. This prevented any craftsman keeping more apprentices than he could support and to whom he could give proper training. There was more than the apparent reason underlying this regulation. In the fifteenth and sixteenth

[1] *Vide* E. Lipson, *Economic History of England.*

centuries the number of apprentices which a master might employ was always a matter of controversy. Some towns removed the restriction and allowed any craftsman to please himself with regard to the number he took; in many cases this practice lent itself to abuse. The attempt to restrict the number of apprentices could be said to have sprung from any one of three motives: the interest of the apprentices, the interest of the journeymen, or the interests of the masters. Journeymen naturally enough were agreeable to restriction of apprentices in order to keep good their own chances of employment, which meant in many instances their only means of saving enough money to enable them to set up as masters in independent establishments. Guild rules fixed a definite proportion of journeymen to apprentices in order to protect the former from the competition of cheap labour. This was later ratified by legislation.[1] The masters, ambitious for their trade, agreed with the non-restrictive policy in such cases where their interests lay in being able to draw freely on a supply of cheap labour, but in the main the masters were conscious of their share in guild monopoly, and showed a decided reluctance to admit any more potential rivals to their calling than was absolutely necessary.

The practice of apprentices just "out of their time" in leaving their masters to try to set up independent establishments was a decisive factor in the later history of the guilds. Apprentices became too numerous and overcrowded the guild to the detriment of the whole craft. The craft guilds did everything within their power to discourage a growth of industrial capitalism among the brethren by striving to prevent initiative on the part of enterprising craftsmen whose ambition it was to become large employers of labour.

Once a year the principal warden of the particular craft guild examined every man's apprentice to see if he was being properly taught, and also to check the fact that the

[1] *Statute of Apprentices* (1563).

youth was being treated according to agreement. The apprentice had the right to complain of any ill treatment, but the obligations on his part were no less binding than the responsibilities of the master towards him. There is much evidence to be found in contemporary documents and records from the entries of punishments meted out to unruly apprentices, as well as charges laid against masters alleging undue chastisement and improper treatment of apprentices, which serves to show that the apprentice was very far from being left unprotected. Nevertheless, the control of unruly youths was not an easy obligation, and the management of wild-spirited apprentices taxed the resources of a guild to the utmost. The system of apprenticeship was a social training as well as a technical training; such a system aimed at turning out not only good craftsmen inspired with loyalty to their guild and city but good citizens willing to give active service on behalf of either if called to the field or council hall.

The guild system of industry was intimately bound up with the institution of apprenticeship. The basis of industry and trade was a high standard of workmanship and a high code of commercial morality; its continuity from generation to generation was held to depend solely on the permanence of the practice of apprenticeship. The purpose of apprenticeship, in the words of the Merchant Adventurers of Newcastle, was to "raise up honest and virtuous masters, to succeed us in this worshipful fellowship for the maintenance of the feats of merchandise." An apprenticeship constituted a wide field of technical training and specialized knowledge in which the worker found ideals of good workmanship and sound quality upon which again the reputation of the guild depended. The qualified workman was protected from the possibility of quack competitors, and this protection of his training and qualifications later developed in the hands of the guild into an instrument of monopoly. The examinations of the skill and progress of apprentices and the qualification of young journeymen by

the guild wardens were intended to protect the skilled artisan, but at the same time they were designed in the interests of the consumer no less than in those of the producer.

Young journeymen, either itinerant or native to the town, had to furnish clear proofs of competence to the wardens and to the mayor before being allowed to set up as a master craftsman in an establishment in a town. Capital, as a rule, played but a very subordinate part in medieval industry. A master's only capital resources were his tools and technical knowledge; and in the earlier stages of guild industrial control his future outlook was promising, as the market was limited, rapid industrial fluctuation in supply and demand were unknown, and there could be few openings to which the skill of a master could not be successfully applied.

Work of Production

The craftsman worked on materials supplied by his customer, so he had no need for extensive stocks of raw materials on hand. No impassable gulf separated employer and employed; the master craftsman was an artisan as much as his journeyman, and he himself was drawn from the same social strata. Thus, industrial conditions rendered easy the growth and sustenance of an identity of purpose and sympathy of outlook between them. The work of production was carried out in the craftsman's own home, but trade was carried on in the shops and halls. The craftsman and his apprentice worked in the front room of the dwelling in full view of the public. This room was raised above the street level, steps leading up to the door. The windows were without glass, as a rule, so that very little of the actual process of manufacturing particular articles was hidden from the gaze of an interested consumer. If a customer contracted with a craftsman for a certain work and the completed article did not meet with his full approval the client could then lay a complaint before the warden of the craftsman's guild. Satisfaction was obtained in the full interests of the consumer. Apart from specific

complaints, the warden of the guild kept a strict supervision over all the work of production in the craft of his guild. On a tour of inspection everything was submitted to the warden's scrutinizing gaze. The record of one search reveals that at Leicester "One Roger Aldith was convicted three times concerning a certain vermilion cloth made contrary to the rules of the guild, 'to wit, with the woof in the middle poorer and worse than at the ends.' His persistence in fraud met its due reward, and he was 'cut off from the guild and separated from the community of the guild brethren.'"[1] Though fraudulent work was condemned, such as the selling of renovated articles as new, or the alloying of metals of inferior quality with those of a superior kind, or selling foreign goods in place of English manufactured articles—"Flanders pins for English pins"—bad workmanship itself, even though performed in good faith, brought down the heavy hand of the guild upon the offender. The rules of the guild of the Blacksmiths of London ordained that any member "found false of his hands" for the first offence would be reprimanded and fined, but for a second offence would be expelled from the craft for ever.

The minuteness with which details of industrial processes were regulated does not presuppose that the medieval craftsmen were necessarily more honest or trustworthy than their descendants. Fraud was carried on in more primitive fashion and demanded much detailed scrutiny. The technical ordinances of the guild were to protect the consumer against unsound articles and to protect the manufacturer against the evils of cheap labour. The ordinances demonstrate clearly how the welfare of industry and ideals of sound craftsmanship were intimately bound up with the fortunes of the guild system,[2] and explain the anxiety of a guild to banish from its membership any who would be likely to damage its good name in the eyes of the public upon whose favour the craftsmen were dependent for their market.

[1] [2] *Vide* E. Lipson, *Economic History of England.*

Hours of Work

Some guilds accepted complete responsibility for damage done to a customer's material by an ill-trained craftsman. The customer was amply recompensed in every case. Regulations of a guild enforcing sound work and a good standard of craftsmanship were rigidly followed up by the guild. Searches by the wardens throughout workshops at unexpected times and in all places were instituted. The hours of work were regulated and work by artificial light was sternly prohibited. This interference with the rights of the individual sounds bureaucratic, but candle-light was held to militate against good work, and, moreover, wardens could not search after sunset.[1] Sunday work was forbidden and also work on certain obligatory religious holidays throughout the year. A reasonable amount of pleasure was necessary for the securing of good work. The craftsman was forbidden to work longer than from the "beginning of day until Curfew," with intervals of half an hour for breakfast, and one hour and a half for dinner, and a half hour for rest in the afternoon.

Division of Labour

The line of demarcation between the work of various crafts was sharply drawn, and in some cases the relationship between different guilds was not always harmonious. The drawing of the line between allied occupations was not easy, and the crafts jealously resented any attempts at what they regarded as encroachments upon their special activities in industry. "The principle, one man, one trade, was well understood in the Middle Ages, though not always realized in practice. At Oxford it was ordered that every man should 'keep and occupy his own proper craft or occupation wherein he hath been brought up, so that by their so doing every one of them may live by the other.'"[2]

[1] [2] *Vide* E. Lipson, *Economic History of England.*

Wages

The assessment of wages and the fixing of prices were common features of craft guild activity, though in the latter case it was not always done in an official manner for fear of awakening the jealousy of the municipal authorities. There was no private bargaining, as the price of each article was fixed. Justice was the dominant note, the cost of production and the requirements of the craftsmen being taken into account, and it was the ultimate costs of production of the article, not its utility or rarity, that finally settled the price.

An example of wage-fixing is found in the ordinances of the Bowyer's guild laying down that a "taskman" who worked by the piece would receive sixteenpence for chipping a hundred bows, and journeymen who were not competent for "taskwork" received twelvepence a week and their food during one half of the year and eightpence a week and their food during the other half. Any employer who withheld wages beyond the appointed day for payment was either suspended from the guild or severely punished in some other way.

Care of the Sick and Dependent

As long as a craftsman did nothing to bring discredit upon his guild, the guild took care of his needs till the day of his death. If at his death his family were in want, the guild provided for the upkeep and education of the children. When a member fell ill the solicitude of the guild was no less; the records of a Southampton guild state: "If a guildsman were ill he should be given two loaves, and a gallon of wine and one dish of cooked food," whilst two of the approved men of the guild were to look to his condition." Similarly, with regard to other temporal misfortunes, such as loss of tools or the inability to buy necessary tools and equipment, the guild came to the needy craftsman's assistance with the loan of money.

UNEMPLOYMENT

The guild control of industry provided measures not only against unemployment of craftsmen but also against shortage of labour. The medieval "labour exchange" was somewhat akin in principle to that of the present day. Craftsmen seeking work were obliged by guild rules to attend at stated times certain places with their tools and there offer themselves for employment. The assembly place chosen was usually the Market Cross or one of the gates of the town; in London it was a particular churchyard, such as the churchyard of St. Lawrence Pountenay, the churchyard of St. Mary Somerset, etc. The hour of assembly was fixed for 5 or 6 a.m. as a rule. The spirit of each guild was, however, opposed to the possibility of any of its guildsmen having to seek work publicly, and individual members were therefore expected to assist unemployed brethren to procure it as soon as possible. "If any brother go idle for default of work," states one guild ordinance, "and another brother have work whereon he may work his brother, and that work be such that his brother can work it, then shall he work his brother before any other and give him as another man would take of him for the same work." [1]

With regard to shortage of labour, guild rules reflected a spirit of joint effort and co-operative action. If one of the guildsmen was unable to complete certain work, or if the work was in danger of being spoilt through lack of assistance, then his brethren were expected to supply him with the necessary aid. The atmosphere of individualism was absent in a system which held that the welfare of one was the welfare of all. As two London guilds ordained: " . . . if any one of the trade shall have work in his house that he cannot complete, or if for want of assistance such work shall be in danger of being lost, those of the said trade shall aid him that so the said work be not lost," and also

[1] E. Lipson, *Economic History of England*, p. 309.

" . . . the wardens shall go to him that hath journeymen and shall take of them such as the goodman of the house may best forbear, and deliver him to him that hath none and hath need to have."[1]

Decline of the Craft Guild: The Origin of Cottage Period of Domestic Production

The sixteenth century heralded the decline of the medieval craft guilds. The guild spirit was undermined and decayed, though not altogether as a matter of course. It had its limitations, but there were antagonistic forces in the field which gave a startling impetus to its destruction. The spirit of competition and the desire for self-advancement had become decidedly evident in the business conduct of the individual guildsman, especially those of more than usual wealth. Among those members the maxim of "every man for himself" was increasingly acknowledged; the corporate life of the guilds received a death blow, and the fraternal spirit which had characterized the craft guild in every stage of its existence was stifled. The development of international, as distinguished from parochial and intermunicipal trade, specially favoured the ambitious traders in private enterprise. More important, however, was the fact that the internal freedom and the independence of the guilds were not in harmony with despotic tendencies of the Tudor and Stuart dynasties. The property of all guilds was, during the reigns of Henry VIII and Edward VI, vested by Acts of Parliament in the Crown.

The seeds of decay had been sown earlier; in the fifteenth century some traders broke from the restraining influence of the guilds and inaugurated a new system of private enterprise, by which the manufacture and the price of certain articles could not be controlled by the guilds. Also, within the guild itself disintegrating influences were always tending to undermine the governing authority.

[1] E. Lipson, *Economic History of England*, p. 309.

Of these the chief causes at work were jealousy arising from the increasing differences in the economic status of the members and an ever-waning loyalty of the members to the parent guild. The craft guilds became even more exclusive and their regulations grew oppressive when the members made use of their position to advance their own interests at the expense of the community. The guiding principle of guild rules, which fought unfair competition on the part of those who trafficked in inferior products, was one thing, but it was a grave distortion of a praiseworthy policy to fight fair competition by excluding rival craftsmen.

Craft guilds were, for the most part, under the control of the municipal authorities; but many guilds had received, in the reign of Henry VI, royal charters, by virtue of which their right to control industry was derived from the Crown. The system of divided authority thus set up had established a situation parallel to that which had existed when the formation of the craft guilds began under the old guild merchant. The State and the craft guilds had come into conflict several times during the fifteenth and sixteenth centuries, but it can hardly be stated that legislation produced the process by which the guild system was gradually broken up.[1] As industrial organizations, legislation did not affect them, however much they may have been affected in development by such acts as the "dissolution of chantries," or other disendowments of their religious functions. Economic forces did, however, exert a most profound influence.

The essence of the craft guilds lay in their ability to establish a system whereby both the mercantile and handicraft aspects of different industries lay completely in the individual hands of the brethren of different guilds. The trades-master craftsman combined in himself the functions of entrepreneur, merchant, and artisan; he handled the raw material, manufactured it into the finished

[1] The Statute of 1504 placed the guilds under national control without affecting the legitimate exercise of their ordinary functions.

product, and sold it to the consumer. While markets were limited and capital was practically a negligible factor, the system responded adequately to the public demands of the age. With the growing importance of capital, and the extension of markets, the two functions of trading and handicraft were differentiated, and the trading functions passed into the hands of a more mercantile class. Within a guild these functions might pass to the more ambitious and enterprising brethren; or a separate group of traders might dominate that industry from without; or one section of the craft might control the remaining sections and commandeer the total trading functions. In any case, the craftsman as an individual was deprived of his economic independence. Production and distribution were separated; the manufacturer lost direct contact with his customer.

The appearance of associations of craftsmen within the craft guilds themselves proclaimed one more disintegrating influence towards the decline of the old guild system. These were wage-earning journeymen, who, by reason of the growth of capital and the gradual emphasis being put on the trading function, were compelled to accept a wage-earning position permanently. They maintained in their associations a separate and, where possible, an independent existence, and were known as yeomen guilds. The small master or employer did not disappear; although he was recruited from the ranks of the hand-worker he maintained his position until the Industrial Revolution achieved the final triumph of the trading or capitalistic employer. In the fifteenth and sixteenth centuries there began to emerge among the trained craftsmen a class of permanent wage-earners, who unfortunately lacked the means to use their craft to their own personal advantage. These hired workers combined together, and the separation of interests between their associations and employers indicated that the old relationship between masters and men would take on a new form under the stress of growing industrial competition and

the pressure of new economic forces. The yeomen guilds, however, failed to establish a permanent organization among the ranks of hired workers.

The Cottage System of Domestic Production

The capitalistic tendency had now firmly established itself in the clothmaking trade. This rise of a class of capitalists, which first appeared during the fourteenth century and became increasingly prominent as the Middle Ages drew to a close, was a decisive factor in a period of transition in the control of industry. It must be noted, however, that although the guild system broke down first in the woollen industry it was not the earliest industry to be run on capitalist principles. The wage system existed in the tin-mining industry from very early times, and often the large tin producers employed about three hundred men.

The new phase in the clothmaking and woollen industry heralded the transference of the industry to the country by a new class of entrepreneurs, who desired to break with all municipal and guild restrictions. This afforded greater opportunities for the development of a new technique and helped to produce a migration of labour from the towns to the country cottages. The cottage period of domestic production separated the place of manufacture from the source of raw materials, and the necessity arose for a new class of industrialist whose function it was to act as a connecting link between the workers in their cottages on the one hand and the source of raw materials and distribution centres on the other. In this way a great increase took place in the number of entrepreneurs and middlemen.

The organization of industry became divided in a threefold manner. The workers, who supplied the instruments and tools of production in their homes, the middlemen, who for the greater part were without capital, and the general public, who were the consumers.

In the seventeenth and eighteenth centuries the centre of gravity of the industrial system had moved decisively from

the worker to the middleman. The yeoman producer who filled his cottage with a number of manufacturing instruments relied more and more upon the middleman to supply him with raw materials and to find a market for the finished product. The middleman found the necessary capital to purchase the manufactured goods and to enable him to undertake the risks of marketing; the workers, out of touch with the markets, were virtually poorly-paid piece-rate workers in the hands of the middlemen. In consequence, industry was solely dependent upon the middleman, and during the eighteenth century there was a marked growth of Capital.

Merits and Defects of the Guild System

The transition from the craft guild to the new capitalist system was a factor in social life, the significance of which cannot be over-estimated. In the guild system of industrial control the control was wielded by the workers themselves through an elected authority appointed by them. The essence of the capitalist system lies in the control of industry being transferred to men who stand outside the ranks of industrial workers, and are frequently in conflict with them. The guild principle strove for order rather than progress, stability rather than expansion, while regulations within the guild tended towards the elimination of competition among the brethren. It was a feature of the early exclusiveness of the craft guild that it tended to keep down the number of trained and skilled workmen. It was only later in the fifteenth century, when industry was becoming more attractive than husbandry in offering a wider scope to enterprising men and opening up wide fields from which wealth and power could be taken by skilful and resourceful craftsmen, that the craft guilds became scenes of contention and strife. The earlier history of the craft guilds emphasizes the industrial harmony of England, when craft guilds brought together in a compact body all who followed a common

calling. Industry being confined within narrow limits, craftsmen were content with one or two apprentices at the most, and as all were drawn from the same social stratum and united by a sense of common interests, masters and men worked side by side in willing co-operation. In the early stages of industrial development masters and men were not divided by the antagonism of capital and labour

Industrial life and social life were intimately bound together, and the regulations of each guild, though framed primarily for an industrial system, embraced also the requirements of a complete social system. In the regulations and ordinances of the guilds were reflected public opinion and the pressure of moral laws. The economic, the religious, the technical, and the artistic aspects of an individual's life were equally the concern of the guild in its control over industrial and economic activities. It may be said that this establishment of complete control tended towards a multiplicity of restrictions. In medieval society the functions of a guild could not be isolated one from another. The regulation of wages went hand in hand with the care for the poor and the education of the young; the altar and the pageant were no less a part of a guild's concern than the regulation of the hours of work.

The guild system undoubtedly had qualities which may still afford guidance towards a solution of many administrative problems of the present industrial age, and certain defects which may still serve as warnings. But in any praise or criticism of the guild system it must be remembered that the economic conditions under which it flourished differed widely from modern economic conditions, and that in consequence its fundamental principles are in many respects completely opposed to modern ways of thought.

The communal aspect of the guild merchant and the craft guild was emphasized in their efforts to promote co-operation and collective bargaining among the brethren. As an organized body of traders the guild engaged in commercial transactions, such as the first bid for the wholesale

purchase of imported cargoes; and these joint purchases, known as "common bargains," were distributed to the guildsmen at retail prices, the profits of which went into the common purse. The practice of collective bargaining had originated in the policy of keeping the stranger merchant always at a disadvantage while promoting equal opportunities for trade among the brotherhood. In this, the embryo can be traced which centuries afterwards received birth as the modern joint-stock company.

In some respects the craft guilds show a resemblance between their industrial organizations and modern trade unionism. Both are industrial organizations with an ultimate and fundamental purpose in the maintenance of the standard of life. The organization of workers to raise the standard of living, and by the co-operation of forces to prevent the degradation of their social and economic status, is the object of trade unionism. A fair and just remuneration for the workers' labour was the concern of the craft guilds; and, in principle, both bodies held that combined action alone can ensure adequate protection for the worker. This principle has survived in the resemblance between trade unions and the older guild system.

It is of interest to note that Mr. and Mrs. Sidney Webb declare that this idea of a connection between the craft guilds and modern trade unionism is fallacious. "The supposed descent of Trade Unions from craft guilds rests upon no evidence whatsoever." [1] The main argument for such a hypothesis lies in the fact that the guild membership contained employers as well as journeymen and apprentices and the guilds were merely carrying out the recognized principles of medieval social life. The guilds had larger aims, more authority, and exercised a more comprehensive control over the working lives and commercial transactions of the members than is possible in trade unionism. But, establishment of funds for sickness or accident and unemployment; the restraints imposed upon the working of

[1] Webb, *History of Trade Unionism*, p. 13.

overtime; the duration of the period of apprenticeship and the limitation of apprentices, are features which have a direct similarity in the objects of both organizations. Otherwise, it cannot be said that one evolved out of the other; the craft guilds were dead centuries before trade unionism was born.

The guild system had handed down as its most conspicuous feature the institution of apprenticeship, the ideal of technical training and sound workmanship—that ideal which is still binding on all in the modern industrial age who maintain their livelihood with hands or brain.

Other conspicuous features include the stimulation of good craftsmanship by the systematic inspection of workshops, the minimization if not the entire removal of oppression of workers by the rigid regulations governing wages and conditions of labour. Also, a standard of living was set up for the workers which was distinctly fair, and which deserves commendation in that regulations for wages and conditions of labour were frequently settled with undoubted bias in the interests of the workers. The interests of the producer and of the consumer safeguarded both in the determination of prices and the standards of quality for all commodities. Because the craftsman was remunerated commensurately with the labour involved and the cost of production was generally a true index of the quality, prices were fixed according to quality. The rate of remuneration for a craftsman was suitable for his station; there never was an instance of wages for craftsmen being forced down to the bare subsistence level. Instead of the theory of minimum subsistence, the method of recompense was a direct application of the theory that the wages paid should be able to maintain a fit and proper standard of life. Individual enterprise had always to give way to the interests of the community.

The craft guild, however, was a detrimental factor against any possibility of a great expansion of industry taking place; it gave rise in most cases to a spirit of

monopoly, and eventually, in the endeavours to maintain a growing exclusiveness, some of the guilds' regulations became harsh and oppressive; outsiders were excluded by the admission fees for guild membership being made prohibitive, and ordinances were sometimes framed for a guild's private advantage and to the public detriment.

The fundamental interest of medieval craft guilds lies in the fact that they represent a distinct stage in industrial and economic evolution in this country, and present a wide field for the comparative study of handling and solving modern industrial problems in the light of the methods of medieval times. Although the industrial problems of to-day are complex and involve much larger issues than of old, modern industrialists find the benefit of the efforts made by the guilds to solve questions such as principles of industrial control, regulation of wages and labour, and the conception of the just price. These problems still remain fundamental issues of an economic environment similar to that of the guild system—to which one day the industrial structure may even tend to return.

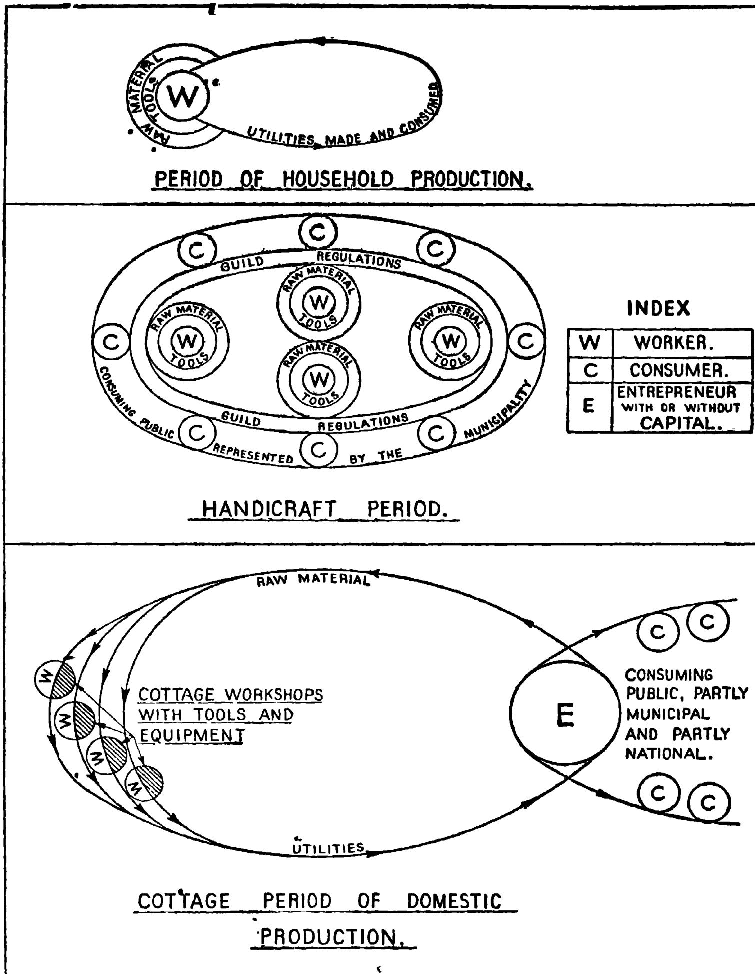
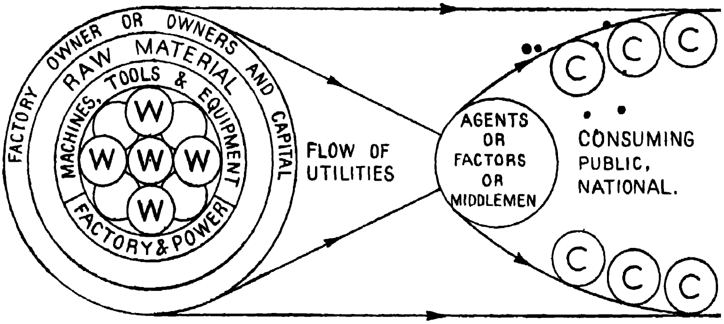
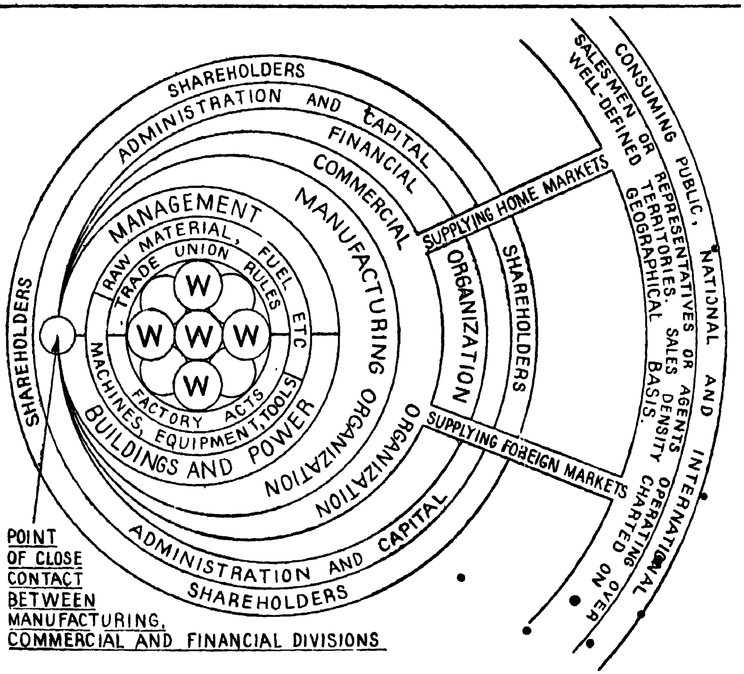

W
RAW MATERIAL
TOOLS
UTILITIES MADE AND CONSUMED
PERIOD OF HOUSEHOLD PRODUCTION.
C
GUILD REGULATIONS
RAW MATERIAL
W
TOOLS
CONSUMING PUBLIC REPRESENTED BY THE MUNICIPALITY
INDEX
W WORKER.
C CONSUMER.
E ENTREPRENEUR WITH OR WITHOUT CAPITAL.
HANDICRAFT PERIOD.
RAW MATERIAL
COTTAGE WORKSHOPS WITH TOOLS AND EQUIPMENT
E
CONSUMING PUBLIC, PARTLY MUNICIPAL AND PARTLY NATIONAL.
UTILITIES
COTTAGE PERIOD OF DOMESTIC PRODUCTION.

FIG. 1



FACTORY SYSTEM



LATER FACTORY SYSTEM

FIG 2

CHAPTER II

THE INDUSTRIAL REVOLUTION

THE CRADLE OF THE REVOLUTION

THE period between 1760 and 1860 saw critical and constructive changes in manufacturing methods, accompanied by a profound transformation in industrial conditions and in social life. These changes rose spontaneously from an ordinary and developing economic practice. The transformation was established so gradually that it is almost impossible to state its exact beginning or where it ended; but it was so dramatic in nature that it earned the popular though misnamed term of "Industrial Revolution." The transformation was too widespread over time to be described accurately as a revolution; but because it was a conspicuous phase in the economic and social life of Great Britain, so importantly characterized and so far-reaching in consequences, it necessitated some very descriptive term: and the arresting nature of Arnold Toynbee's words "Industrial Revolution" is singularly appropriate.

This industrial revolution can be said to have had a greater effect upon the livelihood of men and women than any other event in known history. It altered fundamentally the character of the country by the redistribution of the rural population; it gave rise to an expansion of the population through its highly increased productiveness. Wealth was produced and accumulated in a way hitherto deemed impossible.

The industrial condition of this country dragged on to the latter end of the eighteenth century with methods which had not changed fundamentally for centuries. The preceding decades had, however, witnessed signs of stimulation and an impulse had been given to the industrial structural development of the country in many ways. There

had existed an accumulation and ready command of capital; foreign trade had increased owing to the favourable geographical position of the country being more fully realized, and new markets were still being sought. The former long period of little or no foreign market for surplus industrial products, and the apparent satisfaction of trading capitalists during the era of the domestic system of cottage production, were partly responsible for the continued persistence of inefficient methods of manufacture in industry. There followed in consequence of this an encouragement to inventive minds to solve the problem of accelerating processes of manufacture in order to cope with the prospects of fresh avenues of trade.

There was considerable diversity of organization in the industries of the country during the period prior to the close of the eighteenth century. The factory was not yet an industrial unit in the proper sense of the term. The commanding figure in the industrial field was the merchant, now rendered additionally powerful with his ready command of capital. The volume of imports and exports had increased five times during the greater part of the eighteenth century. The long peace and political security in the country under the ministry of Walpole was a further factor in the preparation of a fruitful soil from which would spring a great industrial growth. Strength built up in commercial expansion, abundant economic resources, unsatisfied customers, half-exploited markets, and countless recruits for labour rendered the environment peculiarly favourable to rapid industrial progress.

The industrial era commenced as a series of slowly determined improvements in the technique of production. There had risen a ceaseless demand from the manufacturers for new methods and new processes by which their material progress would be less hampered, as it was with the widespread and traditional customs that were now hopelessly inadequate to an expanding economic unity and a growing population. A number of historically great figures, the

inventors of that period, supplied the key which, in answer to the demand, was to unlock the multiplicity of doors that opened the way to a great industrial expansion. On the industrial side the series of great mechanical inventions were developed by men like Crompton, Watt, and the Darbys, whose work set fire to the outlook and ambitions of the age. In the intellectual field Adam Smith from the same environment developed his investigations into the Nature and Causes of the Wealth of Nations. Pitt by reviving the Board of Trade gave it a significant economic function, and made it an essential factor in industrial development.

Conditions in England

For many reasons the period towards the end of the eighteenth century was critical for England. She had now definitely passed out of the traditionally agricultural state, *and in the year 1792 the home production of grain had* fallen below the home consumption. By that time capitalistic farming and the land-enclosure system were making headway, and the improved agricultural technique of Young and Townshend and Tull had been successfully adopted. From this new development of land cultivation there had emerged, clearly defined, the capitalistic landlord, the tenant farmer, and the landless, wage-earning labourer; the agricultural population was being regrouped, and from the depressed landless labourers a new urban proletariat was rapidly formed. From 1700 to 1800 the population of England increased from six millions to eight millions.

In the year 1797 the financial affairs of England were falling into chaos. The interference of the French War with Continental trade produced an unprecedented crop of bankruptcies; banks failed, and even the Bank of England, in which a growing merchant traders' capital had been accumulating, had to suspend payment of gold. The shadow of crushing war debt loomed large; it was almost five hundred million pounds. In 1815 it reached eight

hundred million pounds. A succession of bad harvests had reduced tens of thousands of the population to the verge of starvation. A heavy increase in the import of foodstuffs had become essential. The volume of goods for export as a means of payment was, however, inadequate; and the need for accelerating the production of manufactured goods became acute. Necessity stimulated the devising of new machines, new methods, and new processes and produced the favourable environment in which the embryo of the machine age rapidly developed.

The Embryo of the Machine Age

The success of the industrial revolution was based upon the early developments in the metal industries and upon the opportune scientific discoveries of the period. The metal industry, however, was not the first to feel the beneficial effects of the gradual change-over in industrial practice. The mechanization of industry commenced in the textile group; and the cotton industry was immediately affected with a resultant all-round expansion.

In 1733 Kay, of Bury, invented and brought into use a "flying shuttle," a contrivance by means of which the weaver's shuttle carrying the weft through the threads of the warp on the loom was mechanically driven. When perfected and later brought into widespread use, Kay's invention abolished hand weaving and increased the output of the weavers, while at the same time it allowed a wider cloth to be made. The increased output created a consequent famine in yarns, since the speed of yarn-spinning had not been accelerated in proportion. In 1764 a hand-loom worker of Blackburn, James Hargreaves, invented the "spinning jenny" for spinning yarn, which provided eight spindles working in a row and was so mechanically simple that a child could be taught to look after it; the speed of yarn-spinning was increased, but the quality of the yarn was such that it could be used only for wefts. Richard

EMBRYO OF MACHINE AGE IN EIGHTEENTH CENTURY

Events Marking New Stages of Development in the Revolution in Industry

STEAM POWER

Newcomen's atmospheric engine, brought out, 1705; introduced for pumping mines, 1711; used in all collieries, 1725 Much improved mechanically by Smeaton, 1770 —Watt commences experiments on Newcomen's engine, 1763 —Watt patents his improvements on Newcomen's engine, 1769 —Watt's engines widely used in collieries, first Compound Engine (Hornblower, 1781) Watt and Boulton manufacture and sell engines under protected monopoly, 1775–1800

IRON AND STEEL

Coke replaced charcoal for smelting iron (Darby, 1733) —Process for crucible steel (Huntsman, 1740). Production of better tools and implements follows —Invention of Puddling and Rolling Methods for Iron (Cort, 1783–84) —Carron Iron Works founded in Scotland (Roebuck, 1759) —Steam engine widely used to give blasting power. —Wrought-iron Industry revives, 1783

TRANSPORT

Canal cut between Worsley Coal Pits and Manchester by Brindley, 1759, leads to canal boom —First horse-drawn vehicle on rails, 1767. —First cast-iron bridge, 1779 —Telford and Macadam introduce new principles in road construction and maintenance. London Docks construction begun by Rennie, 1798 —Miller, Taylor, and Symington propel a vessel by steam power alone on Dalswinton Loch, Dumfries, 1788.—First cast flanged wheel and rail, 1788. Model locomotive propelled by steam (Murdoch, 1784) —New design and construction of lighthouses —Stimulation in building of larger vessels for more economical transport charges

Arkwright devised a means, however, whereby water-power could be applied to spinning, and patented his "water-frame" (1769 and 1775). His invention provided for the threads being spun by rollers revolving at different speeds, and in its improved form it produced yarn strong and smooth enough for both warps and wefts. This development in yarn-spinning also allowed the weaving of true cotton fabrics for the first time. It was essentially a power machine, and by 1790 the problem of yarn supplies had been solved. In the meantime Crompton had been working upon a machine in which he had combined the ideas of Hargreaves and Arkwright. His efforts appeared in the form known as "Crompton's Mule," and this mule became of great commercial utility, in that it spun a much finer thread than hitherto obtained—thread which was used for muslin-weaving and fine cotton goods manufacture. Crompton's machine was improved and enlarged in order to adapt it for power-spinning. The power loom appeared in 1789, the invention of Arkwright, and it enabled weaving to keep pace with the mechanical processes of spinning, which had overtaken the increased industrial pace of weaving maintained since Kay's shuttle was brought into use.

Within twenty years of Hargreaves's first machine with eight spindles, the number of spindles had been increased to eighty. Two years after Arkwright's invention of the power loom one firm in Manchester had installed four hundred of them (1791). In 1794 Whitney's cotton-gin made American cotton cleaner and more abundant than any other supply of raw cotton, and in America, since the slave system was an important economic factor, the price of raw cotton remained cheap.

A new industrial organization became roughly shaped; a greater division of labour, a rapid growth of the factory system, the development of methods of control in new systems of management and cost accounting, and an improvement in the means of transport with the opening of new markets soon placed the new cotton industry far

ahead of the woollen, which had formerly been the staple industrial organization of Britain.

Wool lagged far behind, hampered by old legislation which imposed rigid standards of size and quality. It was hampered also by the scarcity of raw material, which did not become available in suitable quantity for development of the woollen industry until about 1830.

In linen manufacture the advent of early machinery for spinning flax[1] provided some factors of rapid expansion. Hosiery, lace-making, and silk manufacture were also revolutionized from 1760 onwards; but it was the cotton industry alone that combined both the general and the particular environment favourable for a really rapid development and expansion.

The Metal Industry

The mechanization of the textile industry was in part directly affected by the progress in engineering knowledge. The development of the textile branch, brought forward by the mechanization of processes, particularly those of the cotton industry, offers an interesting comparison to the development of the metal industry. The cotton industry expanded rapidly from its inception, while the iron industry remained undeveloped during the early eighteenth century. The reason for the depressed state of the latter lay in the fact that charcoal was the only fuel used in iron-making; the industry had become semi-nomadic in type, as manufacturers moved from place to place in search of the necessary timber supply. In the search for fuel the iron-makers were also influenced by a dependence upon necessary water communications. An alternative fuel to charcoal became the main condition of escape from the very depressed state of the iron industry, especially as a timber famine was prevalent.

Early in the eighteenth century the Darbys—father and son—re-introduced Dudley's method of using coke as a

[1] From 1790 onwards.

fuel to smelt iron. Though successfully employed by the Darbys in their works at Coalbrookdale from about 1710, with the consequent improvement in the methods of casting iron, coke did not become generally used till almost the middle of the eighteenth century. A wide extension of the use of cast iron developed, and for a time it displaced wrought iron. Development in the wrought-iron industry was, however, an urgent need, and this branch offered a wide field to many experimenters. Two important landmarks of the early history of industrialism were charted when the use of coal and coke removed the iron-smelting from the woods to the coalfields, and when the younger Darby introduced the primitive steam engine to increase the blowing power in the blast furnaces, thus superseding the use of water power for that purpose.

In 1783 Cort replaced the use of hammers for shaping and consolidating iron by his invention of grooved rollers. In the following year he discovered the process of puddling and brought into use the reverberating furnace, which united coal and iron in a scientific formula of production. The wrought-iron industry was directly affected in consequence. The necessary blasting power was obtained from the steam engine—now of comparative mechanical reliability—and the metal industry commenced to emerge from its moribund state to take up for itself a position that would one day develop into that of being an essential element in the world's economic and industrial organization.

In 1759 Roebuck founded the Carron ironworks in Scotland, which initiated the industrial revolution in that country. The use of cast iron—greatly improved in quality due to the big-scale ideas and adoption of the latest founding practice by the Carron works—was widely extended. It replaced wood, brass, and lead formerly used in machine construction; it revolutionized bridge-building; and it gradually became the cheapest material for engineering purposes.

Steam Power

Power-driven machinery was established slowly. The first power drive was the water wheel, and buildings containing them were erected on the sides of suitable streams and rivers; but with the growing elaboration of manufacturing machinery a greater concentration of power became more and more necessary. The steam engine was gradually developed into a commercial proposition and began to be adopted as the popular source of power.

"To Edward Somerset, Second Marquis of Worcester, is due the credit of proposing if not of making the first useful steam engine." (1663.)[1] Somerset's experiments, however, led to no practical result. It is to Thomas Savery, who, in 1698, brought out a patent for a water-raising engine that the distinction should be given of putting forward the first commercially successful engine. This engine found considerable use in the minefields for pumping water, and also was employed in raising water to supply houses or to drive water wheels. As the principles on which the engine was based involved the condensation of steam on the surface of the water, and on the sides of the displacement chamber at each stroke, the consumption of fuel was enormous. In 1705 Denis Papin modified Savery's engine, with a resultant economy of fuel. As the consumption of Savery's engine was, in regard to coal used per amount of work done, some twenty times greater than that of a modern steam engine, and Papin's improvements had only the effect of cutting down this enormous fuel rate by a small percentage, there yet remained a great number of undiscovered fundamental principles underlying the use of steam. While Papin was working on his engine an inventor named Newcomen had attempted to utilize the idea of Savery combined with that of Papin. He introduced an engine which was made up of Papin's piston and cylinder and the separate boiler of Savery (1705).

[1] Sir Alfred Ewing, *The Steam Engine*, p. 4.

Although Newcomen's engine did not offer any appreciable reduction of fuel consumption to that of Savery's, yet after it was introduced as a colliery pumping engine in 1711 it became the more generally used, and in 1725 no other engine was employed for pumping mines. Newcomen's engine held chief place for power purposes for almost three-quarters of a century. Smeaton did a great deal to improve the mechanical details of Newcomen's engine (1770), but although many larger and more powerful engines were constructed the use of this engine suffered a rapid decline. A great event had occurred which was to make Newcomen's atmospheric engine obsolete; James Watt, who studied and experimented in trying to trace and remedy the fault of the enormous waste of steam in Newcomen's engine, had come forward with very decisive improvements. Newcomen's engine, however, may be described as "the greatest single act of synthesis in the history of the steam engine."[1]

In 1763 James Watt, an instrument-maker in Glasgow, while repairing a model of Newcomen's engine for the university, was struck with the idea that the alternate chilling and heating of the engine cylinder was fundamentally wrong. He was firmly convinced that the cylinder should be kept as hot as the steam that entered it, and accordingly, after many attempts, he devised a method whereby the cylinder no longer needed to serve as a chamber for condensing the steam. By fitting a separate condenser, and maintaining a continuous heat in the cylinder by means of a steam jacket, and also using the steam pressure to do the actual work on the piston instead of the atmospheric pressure, he produced a greatly improved Newcomen engine which was much less wasteful of fuel and able to make faster strokes. It was still only a pumping engine, and single-acting, but in those improvements James Watt had pointed out a way which was to lead to the solution of the whole world's power problems.

[1] T. H. Burnham, *Engineering Economics*, p. 152.

An extract from the seven claims contained in Watt's specification for patent purposes of his first engine in 1769 will serve to show how enormously important the ideas were that underlay his work. The first and second claims deal with his idea of maintaining a constant heat in the steam cylinder and the incorporation of a separate condensing chamber into the system. The third claim runs as follows: "Whatever air or other elastic vapour is not condensed by the cold of the condenser and may impede the working of the engines, is to be drawn out of the steam vessels or condensers by means of pumps, wrought by the engines themselves, or otherwise." The fourth claim: "I intend in many cases to employ the expansive force of steam to press on the pistons, or whatever may be used instead of them, in the same manner as the pressure of the atmosphere is now employed . . ." The fifth claim deals with his idea for a rotary engine. The sixth: "I intend in some cases to apply a degree of cold not capable of reducing the steam to water, but of contracting it considerably, so that the engines shall be worked by the alternate expansion and contraction of the steam," and, "lastly, instead of using water to render the pistons and other parts of the engine air and steam tight, I employ oils, wax, resinous bodies, fat of animals, quicksilver, and other metals in their fluid state."[1] These statements are of great historical interest; but, apart from that, they deserve a special study, as they enunciate principles which, more than 150 years after he wrote them, still guide the scientific development of the steam engine.

In 1782 Watt used the application of steam to do work on both sides of the piston, and introduced the principle of cut-off, namely, the use of steam expansively by cutting off the supply of steam when the piston had made only a part of the working stroke and allowing the rest of the stroke to be done by the expansion of the steam trapped in the cylinder. This was then the greatest step taken towards

[1] Sir Alfred Ewing, *The Steam Engine*, p. 12.

obtaining economy of fuel; and one which though improved upon in mechanical details was not superseded in principle. Following the introduction of the double-acting engine Watt brought forward his parallel motion, which consisted of an arrangement of links whereby the motion of the end of the piston-rod attached to the oscillating beam was constrained to move in a very nearly straight line. He also added the throttle valve to his engine for regulating the rate of admission of the steam, and the centrifugal governor which controlled the engine's speed by acting on the throttle. Watt was also responsible for the "indicator," by which a diagram could be automatically described showing the relation of pressure to the position of the piston at any part of the stroke in the cylinder. Murdoch, an assistant of Watt, skilfully seconded Watt's ingenuity, and was responsible for the introduction of the slide valve as a means of controlling and cutting off the steam admission and releasing the exhaust steam.

Watt was a great inventor; his magnificent achievement in the inauguration of the steam age was not, however, entirely a personal triumph. The generous economies offered by Watt's engine enabled it to penetrate industry faster than it would otherwise have done, but the possibilities of its latent power were only slowly grasped. The phenomenal progress made by Watt was not automatic as a result of his inventions; it came about from the collaboration of individuals and circumstances. Matthew Boulton was a partner of Watt when the steam engine was made a more reliable and a more economic power unit. The character of Boulton counted a great deal in the progress made by Watt and in the successful evolution of the steam engine. He possessed a command of capital; his Birmingham works were large and full of ingenious machinery. Boulton had trained a staff of skilled metal-workers in whom Watt found useful colleagues and much help. He was imaginative, patient, and industrially experienced; and it was due to him that Watt found the necessary

favourable environment from which his steam engine could only hope to establish the reputation that would lead it to industrial universality.

In partnership with Boulton, Watt manufactured and sold his engines with great success, in spite of many determined attacks made by rivals on the validity of his patents. Watt adopted as the measure of power the mode of rating, first used by Savery, of "horse-power." He, however, gave it a definite meaning by stating that one "horse-power" was equivalent to the rate at which work was done, when 33,000 lb. was raised one foot in one minute. This estimate was arrived at experimentally, using Clydesdale horses; but Watt purposely raised the value in order that his customers might obtain maximum value in their orders.

In 1781 a contemporary of Watt, Jonathan Hornblower, constructed and patented a beam engine using two different-sized cylinders, through which the steam was passed in turn. Each piston acted on the same end of the overhead beam. It was an instance of the expansive use of steam, as the steam did work on the smaller piston before passing into the larger cylinder. Owing to Hornblower incorporating a separate condenser and an air pump, Watt's patent rights were infringed upon, and construction of the engine was not proceeded with until the expiry of Watt's patent in 1800.

This compound engine, as it was called, was revived by Woolf in 1800. Using steam of fairly high pressure and cutting off the supply before the end of the stroke in the smaller cylinder he expanded the steam from six to eight times its original volume over the two operations. It was a step of the utmost importance in steam-engine development—although it was many years later before it was recognized as such by steam engineers—in that it translated Watt's "first principle" of the cylinder being kept as hot as the steam that entered it from theory into actual practice much nearer than could have been done with a single-cylinder engine. The division of the whole range of

expansion into two parts renders the cylinders in which these separate expansions take place subject to a reduced fluctuation in temperatures.

The compound engine was introduced widely for pumping mines in 1814, but it was unable to withstand competition from the efficient single-cylinder high-pressure condensing engine which had the advantage in simplicity of mechanical construction. This efficient single-cylinder engine was a development of high-pressure steam engine-work by Trevithick, who was responsible for the introduction of comparatively high-pressure steam in England. It was known as the Cornish Pumping Engine. The final revival of the compound engine did not take place until 1845; but the ultimate "compounding" of engines was the most definite improvement on the reciprocating type of steam engine since Watt.

Trevithick was the first engineer to construct a steam locomotive; in 1804 he built a steam carriage which he ran on an old horse tramway in Wales. Ten years later George Stephenson, a Northumberland colliery engine-wright, built a locomotive which was a great improvement on that of Trevithick's and which successfully drew coal loads from the colliery to the Tyne, a distance of six miles. This first commercial success of railway transportation stimulated a further development of steam locomotion, to which a great deal was contributed by the work of Matthew Murray, of Leeds, in track-laying. The impulse given to the first steam locomotive rail transport in turn stimulated factory production; and the acceleration and cheapening of goods transport created a great increase in employment at a critical period.

In 1802 William Symington built and tried a tug-boat, the *Charlotte Dundas*, fitted with a horizontal Watt double-acting condensing steam engine. This unit was used to drive a stern paddle-wheel. The trial was successful, but owing to general prejudice, because the banks of the Forth and Clyde Canal had suffered damage during the trial,

steam-towing did not find that favour which was necessary to make it a commercial proposition. Nine years later, however, Henry Bell built the *Comet*, a steam vessel using two side paddle-wheels, which he ran successfully as a passenger boat on the river Clyde.

The adoption of steam to propel ships was very slow. Small vessels propelled by steam had been experimentally constructed in the U.S.A. and France before 1800 as well as in Great Britain, but the earliest commercial successes were Henry Bell's *Comet* (1811) and Fulton's *Clermont* in New York (1807). These were the first steam boats to ply for hire. It was 1838 before the Atlantic was crossed under steam power alone, and even in 1850 the amount of steam vessel tonnage represented only 5 per cent of the total tonnage of the United Kingdom.

The power possibilities of the steam engine being realized, the advent of large-scale manufacture and its localization near coalfields was inevitable. Coal and iron were then linked together as the material basis of the rapid development of the Industrial Revolution. The development of the metal industries at the same time made possible the progress of the steam engine with those associated engineering manufactures for which it was directly responsible. It was the steam engine that led to the invention of the steam hammer, boring and planing machines, the proper working of masses of metal, and the introduction of accurate methods in the making of machines; and it was steam-power generation that became fundamental to industrial development. In the early stages of industrial improvements practice, however, outran theoretical knowledge, which was, in Watt's time, rudimentary. The early steam engineers little understood what they were doing in actual reality. The hall-mark of the age of hand labour persisted for many years of the nineteenth century. Technical practice began and continued to be built on empirical propositions, or on deductions and instinctive trains of thought, until eventually the perception of important

natural laws brought men into the fields of accurate knowledge by which technical practice commenced to develop its technical science.

New Industrial Technique and Effects

Looking back on the birth of the new industrialism, the wide gap in time of a century and a half smooths out all irregularities of that period of transition, and there appears nothing but a rapid expansion of industries from strength to strength. Looked at closely, the apparent smooth curve of expansion contained many harsh irregularities, as different industries came under a new manufacturing technique at varying rates. The Industrial Revolution proceeded slowly, unevenly, and anything but placidly. The coming of machinery and the coincident discovery of the wide use of applied steam power meant the inevitable coming of factories. In the pre-revolution days the cotton industry had felt the effect of increasing demand and had met it half-way by endeavouring to fill the cottages with a multiplicity of little improvements to increase output, and these additions to the instruments of production were gradually forcing the work out of the cottages. The factory system was then in sight.

The centre of the previous economic system was the commercial capitalist. He organized production and employment. The changing conditions of industrialism made new forms of industrial organizations necessary. These new forms were focused in the factory which symbolized the new system. With the factory came the industrial specialist, and with him the displacement of the old commercial capitalist from the centre of industrialism.

As machines grew larger and more complicated greater quantities of raw material were required to feed them in order to keep them going at an efficient and profit-earning rate of output. The small-scale manufacturers who were forced to compete with much larger enterprises buying huge quantities of raw material, suffered in the competition.

Those who could afford to spend readily and freely in the preliminaries of production rapidly and completely squeezed out the cottage industry type of manufacturer, but only after bitter struggles on the part of the latter for existence.

The earlier organizers of manufacture on a larger scale had themselves risen from the ranks of hand-workers, but they owed their rise to prosperity only to factors such as fortuitous circumstances, inherent enterprise in character, and general good fortune. The less fortunate, of necessity the overwhelming majority, were compelled to accept wages for the labour of tending the machines and doing other work in the large workshops. The old class of owner-workers gradually disappeared. The provision of both the appliances and the labour by the one person, either for agriculture or for manufacturing production, became more and more obsolete; and the distribution of work into the country by entrepreneurs for domestic production was reversed by the new need for the localization and concentration of manufacturing, which compelled the rural dwellers to follow industry to the hastily-erected industrial towns. Manufacture separated into two distinct functions, out of which two classes were formed; these were to emerge later in the clearly defined forms of capital and labour.

The comparatively slow development of big-scale manufacture, with its transitory phase from water-power to steam-power and elaborate machinery, enabled the dominant industrialist to keep pace with the improvements in technique. The command of wide resources became essential to industrial success; no less important was the ability necessary to manage masses of men, women, and child employees and the allocation of labour, and to foresee in an efficient manner the movements of markets. "The capitalists, the owners of factories, and heads of manufacturing and commercial undertakings, moved forward like a disorderly mob to the conquest of markets."[1]

[1] Elie Helevy, *History of the English People*, Vol I, p. 271. *Vide* H. Beales, *The Industrial Revolution*.

Legislation was completely inadequate to deal with the new conditions of industrial development and increased powers of production. Under the pressure of the new economic doctrine the government dropped all control in industry; it ceased to supervise conditions of labour or to regulate hours of work, and ceased to interfere in the question of wages. The former restrictions on labour were given up as useless and unnecessary; for example, the "Settlement Laws" were abolished and the old apprenticeship system of the guilds was completely disregarded. In the textile industry, in the mines, in the iron trade, and in capitalistic agriculture a new system of employment rapidly developed along lines whereby the "freedom" of either employer or worker was stressed. It became a private arrangement which either party could break and end freely if it pleased them. This was known as the establishment of "freedom of contract," and in actual practice the workers were placed wholly at the mercy of the employer.

There was an enormous inflow of labour to all new industrial centres brought about by the break-up of the "open field" system in agriculture and the enclosures, and also by the disappearance of the cottage system of domestic production. This meant an ever-increasing free labour force of which the expanding factory system absorbed a great deal. The rising population and the inequality in the expansion of individual industries never permitted a total absorption of the available workers. There was always a large reservoir of floating labour power to draw from. Adam Smith's *Wealth of Nations* convinced the new industrialists that factors such as conditions of labour, wages, and hours were completely outside their control. Two considerations appeared to them as being fundamental and incapable of readjustment. First: If there are more workers than jobs for them wages must fall. Second: If there are more jobs than workers the workers will be in an advantageous position to bargain to their own benefit.

Competition was the prominent feature in industrial life for both factory owners and master capitalists and the masses of the workers. Extension of individual industries was, at that period—by reason of the keen competition—made possible only by severe and continual reduction of the workers' wages. And for any one vacant space in the ranks of the employed "hands," brought about by either illness or death, a hundred workers would immediately clamour. In that struggle to live labour recognized that the new labour-saving machines, the new disciplinary system, and the industrial capitalist were the fundamental causes of their starvation and their unemployment, and grave labour riots, involving the destruction of labour-saving machinery, were common occurrences. The numerical strength of the workers did seem to offer encouragement to unite against the reductions of wages and for an improvement in their conditions of labour, and it was at this period that the trade-union movement appeared, with the strike as its potential and powerful weapon.

The employers, however, soon learned how to safeguard their own interests. They obtained sharp legislation in their favour against loom-breaking (1782). They made certain of the failure of the incipient trade-union formation by "Pitt's Combination Act" (1799), which forbade, under penalty of imprisonment, any workman to combine with any other workman to gain an increase in wages or a decrease in hours. In Bolton (1799) an employers' "black book" of difficult workmen was a well-recognized fact.

The new industrial capitalism was the embodiment of the spirit of competition. But the spirit was not new; premonitions of its ultimate conquest became apparent during the Puritan Revolution, and it attained maturity under the transforming influence of the Industrial Revolution.[1] The manufacturers instinctively sought measures by which to safeguard their own interests and fought against anything which might militate against their freedom to control

[1] *Vide* H. Beales, *ibid.*

as they willed that which they deemed as their own. They firmly believed in the right to do as they pleased with their own, whether it was the factory or the "hands" in the factory. They were, as manufacturers and employers, dominant and authoritative, and their domination and authority were not readily questioned. The unsavoury reputation of the factory system was the natural consequence of this gospel, which has been, from all historical facts, associated with long hours of unremitting toil for men, women, and children, harsh discipline, wages below bare subsistence level, a lowering of the standards of living, the evil of the truck system, the systematization of pauper child labour, the slum dwellings hastily erected in atmospheres of contamination, and the tyrannical repudiation of the workers' right to combine in their own defence.

The factories were built for the industrial capitalists' own immediate needs. Light and air space were considered of negligible importance. Sanitary arrangements were a matter for the workers themselves. The buildings were overcrowded with machinery and workers, and there was insufficient ventilation. Machinery was unfenced and exposed, and the question of fatal accidents came under the mutual "freedom of contract" clause. The worker knew the risk and it was his own concern if anything happened to him. There were no compensation awards, even for loss of life. For every vacancy there were more than a hundred persons waiting to fill it.

Hours of labour were set by the limit of human endurance, which represented from twelve to fifteen hours per day. There was but one break at midday. Wages were regulated by the driving force of competition. Maximum work for minimum remuneration was necessary when rival factories were following a similar policy. There was competition among the workers themselves; each willing to accept lower and lower wages for the bare sake of employment, which was their sole refuge from the spectre of starvation. The average rate of payment was one shilling

a day for men in the textile factories. Owing to the struggle for existence women entered into the competition for work in the textile mills with the men. Their rate of wages amounted to fourpence a day. Then children were compelled to assist in the struggle whereby the extra pittance earned might increase the family subsistence. Children, of six years of age even, had to undergo thirteen hours of monotonous toil daily for one penny. The textile machines were comparatively easy to control, so the mills were filled with the cheaper labour of women and children. A youth or a girl could be placed in charge of four machines at once, and the output per day amounted to nine times that of the old hand weaver.

The conditions in the mining centres were worse than those of the textile mills. The work was more exhausting, the hours were as long, and the wages were appallingly low. The historical descriptions of evil conditions relate chiefly to the cotton mills, but there were more disgusting conditions of serfdom, or worse, persisting in the mining areas for a longer period—until the great commissions of inquiry, one being the Report on Mines (1842), shocked the public conscience of England.

Genesis of the Crisis of 1815

The period from 1760 to 1815 was remarkable for the great contributions to material progress and economic unity; it was also marked by a social retrogression over many years of unrelieved gloom. While company promotion flourished and grew under the extension of commercial opportunities, and the boom of the mechanical age followed the exploitation of steam power in revolutionizing the textile industries, industrial conditions were allowed to find their own level in accordance with the law of supply and demand. To that policy of freedom and non-interference historians have applied the term "the policy of *laissez faire*."

The rapid rise of the factory system, with its particular

economic relationships and its new discipline, has been judged, in many cases, to have been a prime factor in the growth of all the evil conditions during that period of economic expansion. The factory did impose a new discipline, but it did not bring into being a new economic relationship. The factory system took over and adapted to its own use the pre-factory system of employing women and child labour. The customs of the preceding era of industrialism constituted its inheritance, and the long hours of labour and the hostility of workers' unions were not new.[1] The records of agricultural conditions of employment, of coal-mining, and of handloom weaving show a state of affairs in the treatment of the human element as bad as that in the new factories. Apart from cotton spinning and other branches of textile work, the industries which were really revolutionized, in the full meaning of the term, were not of the "sweated" type. The works of Matthew Boulton and the Carron Works, and many others, show in their internal arrangements an example of how all factories, mills, and works should have been run; but, as will be shown, there were antagonistic forces in the field which tended towards changing the normal use of the resources of wealth, knowledge, and power in creating a social life into an abnormal abuse of them. The evil conditions of industry existing fitted harmoniously into an age which, in the severity of its crime laws, made trivial offences (such as the theft of one shilling) capital offences—there were 160 public executions in 1760; they rose to 220 by 1837. Famine, plague and pestilence, and crime, combined with the total ignorance of the masses, all helped to harden and brutalize the community and deprive it of hope, ideals, moral control, and the finer side of life generally.

To some extent the horrors of the period were the result of conditions beyond the average factory owner's control. The coincidence of the French Wars with a rapid industrial development had an adverse effect on trade and employment

[1] *Vide ibid.*

which, as a factor of disturbance, prevented adequate attention being drawn to the state of social conditions, and was responsible for the wild fluctuation in the prices of the necessities of life. The war, and not the Industrial Revolution in itself, was the dominant feature in determining the course and the conditions under which industry would travel during the close of the eighteenth and the early part of the nineteenth centuries. But no influence of the war can account for degradations of industrial life such as the conditions in the mining industry which were permitted to continue until 1842, the systematized exploitation of pauper child labour and of women, the abuse of the truck system, and the antipathy to workers' combinations. These were particular to the age and formed the inheritance of the preceding and essentially capitalistic regime of domestic production. The public conscience had not developed sufficiently to be made aware of the fundamentally evil principles which underlay the manner of building up a new and mammoth industrial superstructure.

In the economic expansion patriotism was invoked by the master capitalists to further the policy of rapidly increasing the productive system or the taxable wealth of the country —even at the expense of wages and labour conditions—whereby provision of the necessary means to combat the menace of Napoleon would be secured. The idea of social justice did not form any part of industrial policy; if it had done so, the reform of the Poor Law of post-Waterloo England would have been a real reform; and the new and hastily-erected industrial towns would have contained at least a bare provision for the elementary amenities of the workers' life.

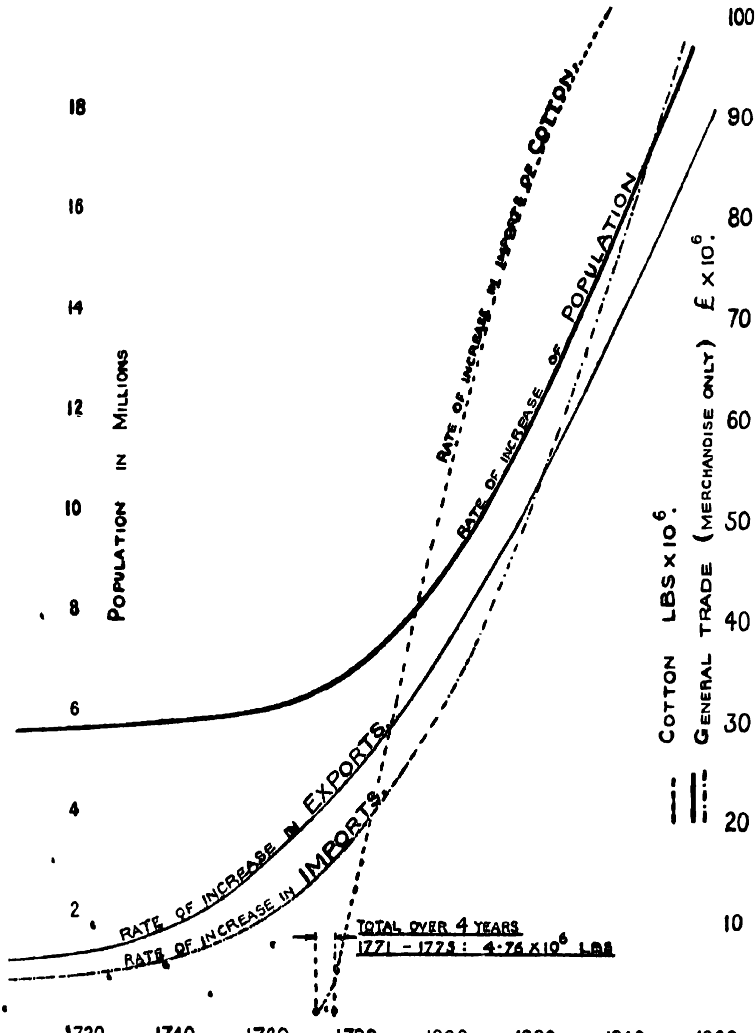
The effects of the war showed the spurious nature of some of the apparent industrial prosperity engendered by it. Peace found manufacturers with large surplus stocks on their hands; factories were closed down and the unemployed figures increased. Purchasing power fell at home and also on the Continent ravaged by the wars. There was

no alleviation in the form of an enlightened economic remedy from the Government. The Corn Laws passed to protect the interests of the rural landlord, and also many indirect taxes on articles of common consumption imposed to offset the effects of the post-war removal of the income-tax, had the effect of raising the general price level and made life more difficult than ever for the workers and the unemployed. (The upward trend of prices in articles of necessity was sharper in foodstuffs than in anything else, e.g. in 1740 wheat was 30s. per quarter; in 1813 it had reached 155s. per quarter.)

Paralysis of foreign markets, due to the war and its immediate after-effects, a simultaneous reduction of the small peasantry, the growth of a great industrial population, and a succession of bad harvests which had emphasized the dependence of the urban proletariat on foreign foodstuffs, served to demonstrate in an unmistakable manner that the industrial structure had been erected too hastily. The first industrial and economic crisis, the crisis of 1815, developed as a result.

In the process of economic expansion, and of the cheapening of commodities, the standards of living were raised; and a large increase in employment was provided to meet the critical needs of a fast-growing population. The following curves and figures present a brief aspect of some of the results of the new industrialism in England over the first period of the Industrial Revolution. (Figs. 3 and 4.)

The masters in the new industrialism were self-confident, constructive, and acquisitive. They laid firmly the foundations of the industrial structure; and the imprint of their efficiency was apparent on the results—the railways, the ships, the bridges, the roads and canals, the harbours, the elaborate machinery, great individual fortunes, and a complete and intensively productive system of wealth. The results of their inefficiency lie in the areas of back-to-back slum and cellar dwellings, wage-cutting to below bare subsistence level, the creation of generations of a proletariat



18
16
14
12
10
8
6
4
2
POPULATION IN MILLIONS
100
90
80
70
60
50
40
30
20
10
COTTON LBS x 10⁶.
GENERAL TRADE (MERCHANDISE ONLY) £ x 10⁶.
RATE OF INCREASE IN IMPORTS OF COTTON
RATE OF INCREASE OF POPULATION
RATE OF INCREASE IN EXPORTS
RATE OF INCREASE IN IMPORTS
TOTAL OVER 4 YEARS
1771 - 1775 : 4·76 x 10⁶ LBS
1720
1740
1760
1780
1800
1820
1840
1860

FIG. 3

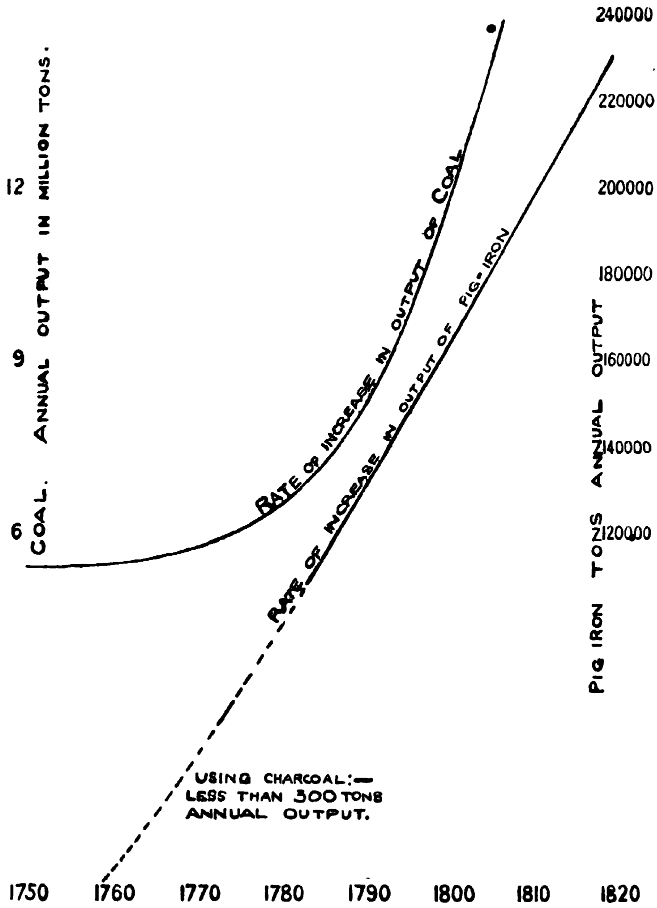

COAL. ANNUAL OUTPUT IN MILLION TONS.
12
9
6
240000
220000
200000
180000
160000
140000
120000
PIG IRON TONS ANNUAL OUTPUT
RATE OF INCREASE IN OUTPUT OF COAL
RATE OF INCREASE IN OUTPUT OF PIG-IRON
USING CHARCOAL:—
LESS THAN 300 TONS
ANNUAL OUTPUT.
1750
1760
1770
1780
1790
1800
1810
1820

FIG. 4

with a C3 health standard, and a permanent cleavage between labour and capital, following the total degradation of the working classes. It is against their individual rapacity that the chief count in the reckoning against the new factory system lies.

The crisis of 1815, and the following crises up to 1847 bore a certain primitive character and were almost entirely confined to England. The chief influence lay in the technical aspect of industry, where the industrial capitalist had first acquired control whilst the labour masses acquiesced in comparative stupor. Under such circumstances the spirit of *laissez-faire* found a rich soil in which to develop. Individual freedom and economic freedom provided the necessary and unrestricted surroundings for growing capitalism, in which the weaker succumbed without effort and the survivors accumulated more and more means of production and capital within their own power. Industrial capitalism gradually took over the controlling influence in government, and the State became its servant. Crises became regarded as inevitable, a natural necessity of prosperity; and it was not until half of the nineteenth century had passed that the social question was able to bring industrial capitalism to a temporary pause to consider its claims. Also, about the same date, England and Europe had been merged together in a new sort of industrial relationship, which was to formulate their common industrial destiny.

CHAPTER III

A CENTURY OF INDUSTRIAL AND TECHNICAL DEVELOPMENT

THERE are many salient characteristics of the industrial development in the century following the first utilization of inventions and the early application of machinery to industrial products.

The enormous advances in transport and communications, the development of international as well as national trade organizations, the alterations in the structure and financial control of industry, the rapid increase in the number of joint-stock companies, the growth of mass production, standardization and simplification of products, the enormous increase in and multiplicity of utilities and commodities placed on the world market, the many and varied results of scientific investigations for industrial purposes, and the great advances in the utilization of electric power are the outstanding evidences of the technical and industrial progress between 1815 and 1915.

POWER GENERATION

The keystone in the arch of the industrial development was the progress made in the generation of steam power. The brilliant contribution offered by Sadi Carnot in 1824, when he published his *Reflexions sur la Puissance Motrice du Feu,* may be said to have ended the engineering phase based upon a rudimentary knowledge of steam theory. The scientific side developed slowly at first, and it was not until 1843, when Joule established his mechanical equivalent of heat, that the theory of the steam engine and of other heat engines began a vigorous growth. From 1847 the science of thermodynamics developed with extraordinary rapidity, and the progress was maintained successfully, due

mostly to the lucid contributions given by Regnault, Clausius, Rankine, and Kelvin.

In 1884 steam-power generation was diverted into fresh channels. Sir Charles Parsons, utilizing the fundamental conception of splitting up the fall in steam pressure into small expansions over a number of moving vanes, exhibited the practical application of the idea in the Parsons Turbine in 1887. Four years later he introduced the condensing turbine. The energy of low-pressure steam was thus able to be utilized right through its expansion to the highest practicable vacuum. From 1891 the steam reciprocating engine was faced by a formidable rival, which possessed constructive simplicity and the ability to generate power on the largest scale with a high degree of economy.

The beginning of the twentieth century saw the earlier inventions of internal combustion engines brought into commercial use. The application of power generation was revolutionized. Industry was stimulated in the manufacture of substitutes, but the real and decisive influence of the development of internal combustion engines became readily apparent in land, sea, and air communications and in the manufacture and use of agricultural machinery. The whole area of the globe was affected during the first part of the century in transportation, communication, and mobilization of forces, and in the cultivation of vast areas of land.

The opening of the twentieth century also saw a strengthening of the industrial structure, which had been built upon engineering progress, by the increasing application of the force of electricity. Electrical developments took full advantage of all the discoveries and improvements made in steam power generation during the nineteenth century. Though not a source of power in a primary sense, the dynamo, utilizing all existing forms of power generation, changed the direction of industrial development fundamentally.

Iron and Steel

From Neilson's hot-blast process for cast iron in 1829, Nasmyth's invention of the steam hammer in 1837, Bessemer's converter process for cheapening the production of steel in 1856, Sir William Siemens's open-hearth furnace which largely replaced the Bessemer converter in. this country from 1870, and the discovery by Gilchrist and Thomas of how to eliminate phosphorus from phosphoric iron ores in 1878, a series of inventions and technical developments rendered possible an ever-increasing output on a vast scale and in numerous different qualities suitable for varying purposes.

The whole progress of engineering during the century depended upon the provision of suitable metals, of which steel is the most important. In 1882 manganese steel was discovered by Sir Robert Hadfield, a steel non-magnetic and specially suited for particularly hard wearing conditions. Two years later silicon steel came into use, and its discovery hastened the technical progress of electrical engineering. From 1899 numerous other steel alloys were invented. Steels alloyed with chromium, nickel, and nickel-chromium were found to possess a toughness which made them specially adaptable for many new engineering purposes. Steels used for cutting tools, when alloyed with tungsten with or without chromium, vanadium, or cobalt kept a sharp cutting edge even when heated to dull red. Many steel alloys were discovered to resist most forms of corrosion; the chief among which is now known as stainless steel.

Side by side with the enormous development of iron and steel industries in Great Britain a corresponding development, dating from the latter end of the nineteenth century, took place in the production of iron and steel in continental countries and in the U.S.A. "By 1900–4 the continental output was fully double that of this country, and Germany alone produced almost as much pig iron as the United Kingdom. The United States produced almost twice as

much as this country. By 1913 Germany produced half as much again, and Continental Europe as a whole over three times as much as this country, while the United States production was also three times as great as that of the United Kingdom."[1] (See Fig. 5.)

INDUSTRIAL CRISES

The first quarter of the nineteenth century saw the industrial revolution almost complete, with the doctrine of *laissez-faire* firmly established, but with no attempt at that reorganization of society which the revolution had rendered necessary. By the time the last quarter of the century was almost spent the principle of *laissez-faire* was being gradually abandoned. Capital had been organized by means of a series of Limited Liability Acts which canalized the savings of all classes of the community. Labour had been organized by means of trade unions which enabled the workers to bargain collectively with the employers and to protect their own interests. The Government had begun to regulate industrial conditions. Parliament poured forth Factory Acts, Education Acts, Workmen's Compensation Acts, and all kinds of Acts dealing with protection of children, prevention of disease, hours of work, and other factors influencing social conditions generally.

It will be sufficient to note that between these two industrial landmarks the commercial era did not prosper evenly. Crisis followed crisis. The first occurred in 1825, the next in 1836, and again in 1847. During the years between 1815 and 1847 Britain's exports had increased by over 300 per cent; but the industrial framework and credit had been subjected at intervals to much strain, and the crises ensued.

After 1847 new inventions were rapidly taken over from one country to another. Industry had extended its area as the mileage of European railway lines was multiplied

[1] Committee on Industry and Trade, *Survey of the Metal Industries*, pp. 5–6.

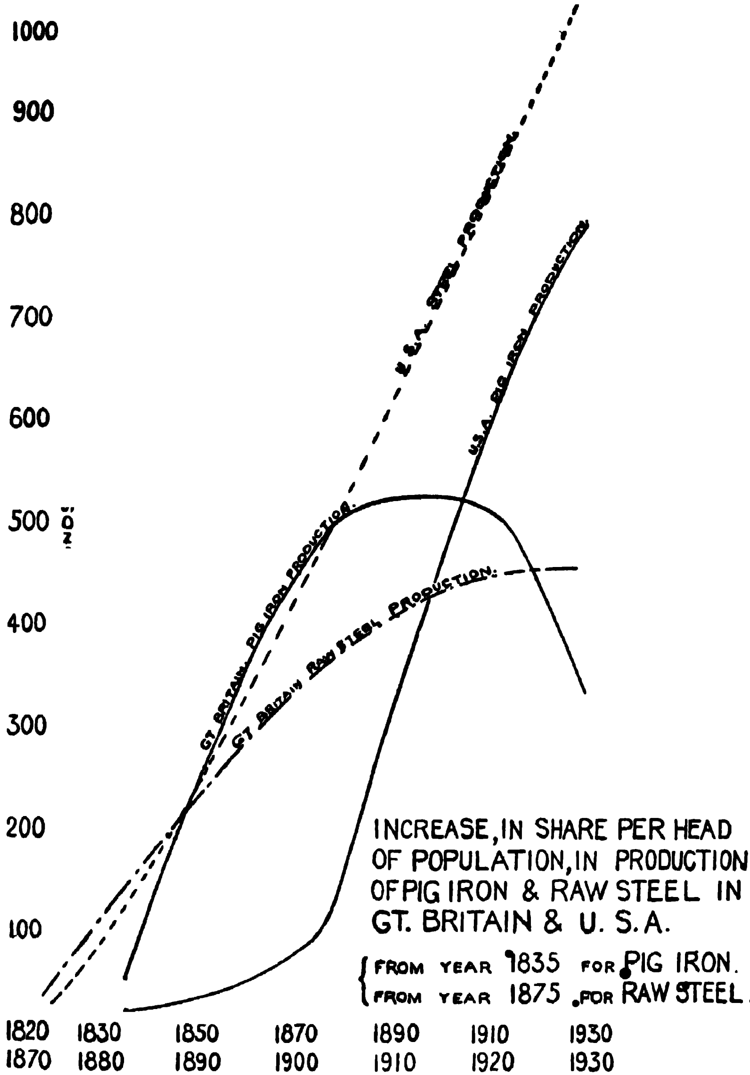

1000
900
800
700
600
500
400
300
200
100
U.S.A. STEEL PRODUCTION
U.S.A. PIG IRON PRODUCTION
GT. BRITAIN. PIG IRON PRODUCTION.
GT. BRITAIN RAW STEEL PRODUCTION.
INCREASE, IN SHARE PER HEAD OF POPULATION, IN PRODUCTION OF PIG IRON & RAW STEEL IN GT. BRITAIN & U. S. A.
FROM YEAR 1835 FOR PIG IRON.
FROM YEAR 1875 FOR RAW STEEL.
1820 1830 1850 1870 1890 1910 1930
1870 1880 1890 1900 1910 1920 1930

FIG. 5

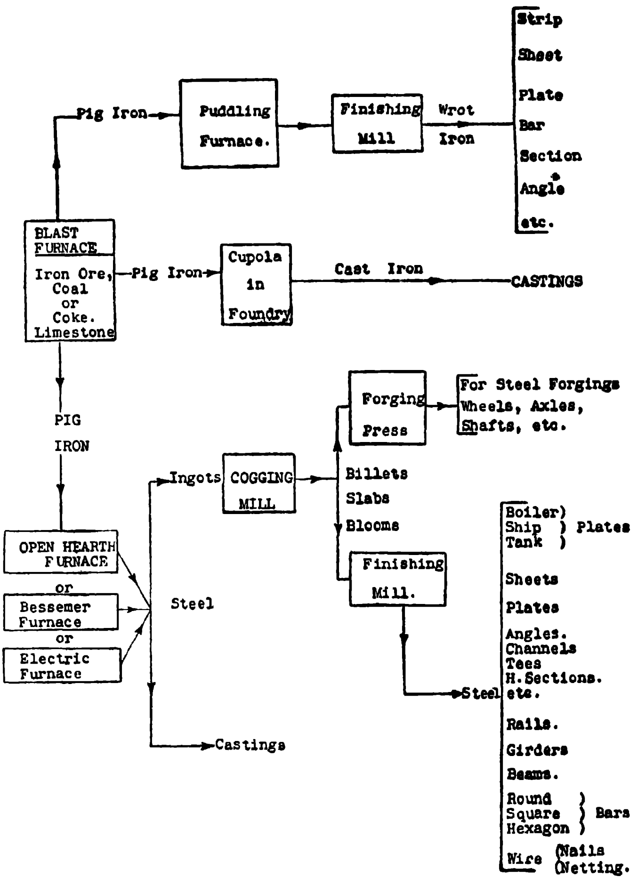


FIG. 6. IRON AND STEEL INDUSTRY · DEVELOPMENT OF PROCESSES DURING THE NINETEENTH CENTURY

without ceasing. War in Europe, in the East, and in North America dealt heavy blows to the fast-growing channels of trade. Eventually the whole industrial structure shook, and as railway companies and banks collapsed a crisis lasting from 1863 to 1869 swept over industrial Europe and North America with Britain in the centre.

The next crisis had Germany as its centre. The Siemens-Martin process, new chemical discoveries, a growing expansion of industry, a 100 per cent increase in the mileage of railway lines, and a rapid rise of company promotions and greater speculation had given an impetus to the productive capacity of industry and had increased the urban population at the expense of the rural. With the unparalleled boom in investment, prices rose to phenomenal heights; in 1873 the first collapse due to over-speculation took place in Vienna. The crisis spread from Austria to Germany, to England, and to the United States, and it was 1876 before this crisis had expended itself.

The effects still lingered and interest rates were very low during the succeeding decade. While industrial production was checked a little, financial activity on the part of every European state developed rapidly. Meanwhile new inventions and their exploitation gave industrialism a fresh impetus. The basic process, by which phosphorus is removed from iron, was discovered in England; but Germany, thus enabled to use her phosphoric ores, reaped the advantage, and struck the first blow which was to deprive English iron ultimately of its position of world dominance. During the last quarter of the nineteenth century Europe's population increased by 77,000,000, of which the greater part was an increase in the new urban populations. During the same period the industrial trade of England, France, and Germany rose by £524,000,000; the effect on overseas transport was an increase in the mercantile marines of England, France, and Germany of 520 per cent, 252 per cent, and 1540 per cent respectively.

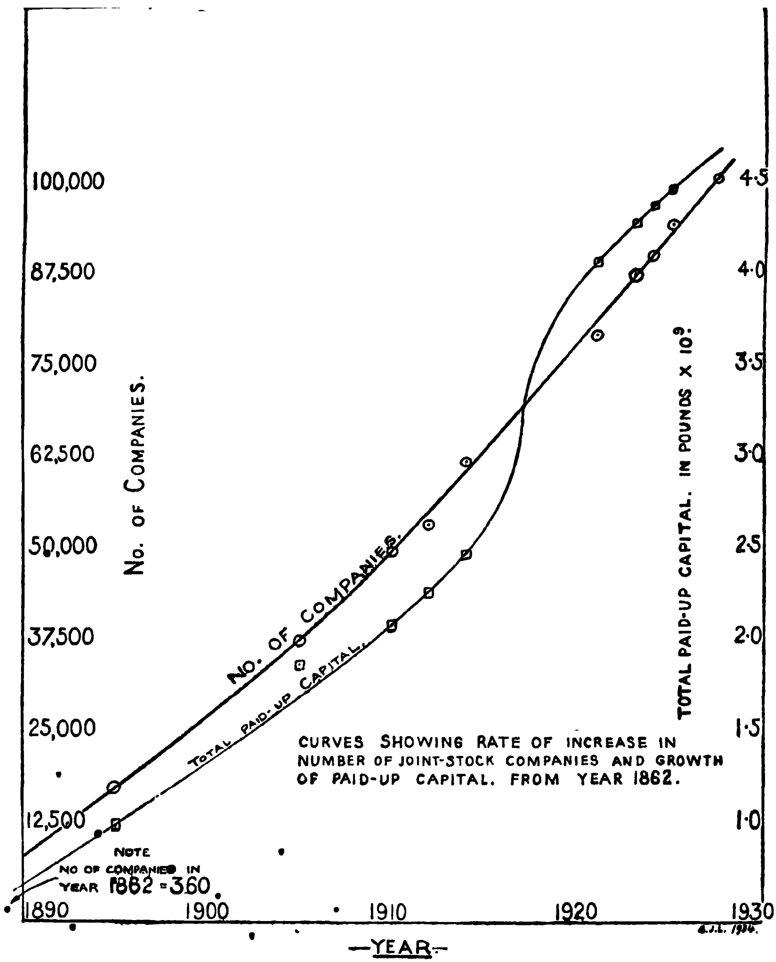

100,000
87,500
75,000
62,500
50,000
37,500
25,000
12,500
No. of Companies.
Total paid-up capital. in pounds x 10⁹.
4·5
4·0
3·5
3·0
2·5
2·0
1·5
1·0
No. of companies.
Total paid-up capital.
Curves showing rate of increase in number of joint-stock companies and growth of paid-up capital. from year 1862.
Note
No of companies in year 1862 = 360.
1890
1900
1910
1920
1930
—Year—

Fig. 7

In 1860 the number of steam ships in the world was 860; in 1900 it was 12,300.

The stock-exchange laws encouraged the wider diffusion of ownership by means of large banks and joint-stock companies. In fifty years the number of joint-stock companies increased from 360 to over 100,000. Capitalism grew too large to rest solely upon the foundation of industrialism; accordingly, its functions were subdivided and there rose up financial capitalism, stock-exchange capitalism, cartel capitalism, and trust capitalism. By 1900 185 monopoly trusts had been formed with an estimated capital of over £1,700,000,000.

From the crisis of 1873 European industry passed through several minor crises as the general oscillation of boom and slump imperceptibly developed. It was an industrial condition which might be said to be a reflection of the movement of gold. The harnessing of gold in the service of international commerce caused the demand for it to grow. Gold rose in value and depressed the price of commodities. During the last five years of the century the quantity of gold available was increased. The price of gold fell, commodity prices rose rapidly, speculation increased and consumption declined, while the productive capacity of industry kept expanding. With the falling prices businesses and banks collapsed and the crisis of 1900 was at hand. The crises between 1815 and 1900, mentioned above, will be considered in greater detail in a later chapter.

From 1900 to 1914 the rise of those forces which were to influence profoundly the nature of production became apparent in the industrial structure. Primarily, they were forces in the increasing development of technical scientific knowledge. Countless series of electrical developments, an incalculable increase of chemical products, a vast improvement in engineering knowledge foreshadowed the mass output of utilities as: cinematographs, gramophones, wireless apparatus, cameras, motor-cars, aeroplanes, tractors, engines for all grades of oil, artificial nitrogen,

artificial petroleum, artificial silk, dyes, large electric motors, midget motors, high-tension apparatus of many hundreds of thousands of volts, and many others.

Between 1900 and 1913 the volume of production of raw materials increased in the extensive industrial activity as follows—

Material	From	To	Increase per cent
Pig iron (U S A and Europe)	$36 \cdot 8 \times 10^6$ Tons	$72 \cdot 4 \times 10^6$ Tons	96
Copper and Zinc	—	—	90
Coal	767×10^6	1345×10^6	76

By 1907 there was a slight check to the too rapidly liberated forces of production, but before a critical point could develop industry had again surged onwards; Great Britain alone suffered in the break of the boom in that her position of dominance in world industrial activity had been seriously challenged.

The complex economic system that was inextricably interwoven with the ever-increasing industrial super-structure would have proved inefficient, if not altogether unworkable, were it not for certain influences which, operating on the system, enabled it to function. The most important of these influences is the expansion of the money belonging to the community by the ordinary banking system. The basis of orthodox banking methods is the metal gold. This is used as an automatic check on the free expansion of the money in the hands of the general public. However much money society may demand, "sound finance" will always ensure a wholly arbitrary limit. Directly the money cannot be expanded with the expansion of productivity the first signs of industrial retardation appear. An obvious palliative is to place the surplus of production on foreign markets, and the only way to relieve immediately the signs of industrial retardation at home

is by granting long credits. All the great nations of the world had been trying to force others to accept goods from them. Markets became fewer; and an intensified competition for foreign markets eventually led to the inevitable result of deep-seated economic disease, namely—war. And the Great War of 1914–1918 was actually the outcome.

THE "SCIENTIFIC" OR SECOND INDUSTRIAL REVOLUTION

THE CRISIS OF 1921

Looking back on the different epochs of industrial history: household production, craft guilds, domestic and early factory period, we may note that, although it is impossible to define chronologically the exact beginning and the end of any one system, each type of organization was a natural offspring of the preceding form, produced as a result of changing external conditions and, in great part, as a result of the change of power applied—as from hand to water and wind, and then to steam. We may say that "the guild system is associated with town economy, the domestic system with the national economy, and the factory system with world economy." [1]

The Great War and the immediate post-War years form the period of transition for British and European industries; it was a transitional phase marked by two outstanding features—destruction and great creative power. The rate of production in industrial undertakings was speeded up enormously. Developments in methods of manufacture and further advances in scientific and engineering knowledge took place during the War years that normally should have extended over the whole twentieth century.

The immediate post-War years marked the commencement of a "scientific" or second industrial revolution. When peace came, the people of Europe tried to find their way back into the old deserted channels of industry, and in

[1] G. Unwin, *Industrial Organization in the Sixteenth and Seventeenth Centuries*, p. 10.

the long phase of recovery of pre-War industrial habits it was apparent that industrialism as far as it affected the individual would not be quite the same. The immediate results of industrial recovery were felt in the more materialistic policy of reconstruction of national assets and in efforts towards the firmer establishment of social and economic functions. The change in industry was essentially a change in the function of employing. That is, increasing attention began to be paid to the human element.

Far-reaching social schemes were mooted; working conditions were constantly being improved; hours of labour were cut down and new channels for the articulation of labour were provided by works councils and other schemes. Legislative efforts tended to make education more general and available to all members of the community. The use of labour-saving machinery became a factor of increasing importance in industry. Scientific research began to show many practical results in the successful elimination of various forms of waste, and in the discovery of new sources of natural wealth. Production was increased and the human effort expended in industrial processes was reduced. A more highly educated type of manager appeared in industrial undertakings, and to some small extent labour's demand for a share in the management was met.

The outstanding features of the transitional period for the new era of industry had been destruction and great creative power. Manufacturers and producers turned out at enormous speed utilities and commodities essential for the conduct of hostilities which were destined to immediate destruction. During the War the question of surplus consumption was solved, and industry untrammelled performed miracles. The problem of sound finance was shelved temporarily; new money being created to keep pace with the wholesale destruction of the wealth produced in industry. It was a paradox that the War, an orgy of waste and destruction, brought to many people a material prosperity and economic freedom unknown to them in times of peace.

The stimulation given to the manufacturing and producing capacity of the country had, through the immediate post-War years, the effect of creating an appearance of a coming era of unlimited prosperity. It was a false atmosphere, and its spurious nature was due to the artificial stimulus provided by increased purchasing power, which fostered uncontrolled spending.

Many countries, deprived during the War of normal supplies of certain materials and commodities, endeavoured to supply their deficiency by seeking other sources, or substitutes for the materials, and by manufacturing the commodities themselves. And during the critical post-War period the new industries created made strong demand for tariffs on competitive foreign goods to protect their own growth and development. New industries were created in China, India, Brazil, Japan, Italy, Australia, and Canada. In Italy almost every branch of industrial activity was represented in the many efforts made to produce in the country goods hitherto imported. The establishment of newly-defined European states led to the creation and growth of certain domestic industries within those states.

These countries, and particularly the U.S.A., whose enhanced financial position made it possible for her to grant long trade credits and whose industrial structure had suffered a minimum of dislocation due to war strain, entered into keen competition for Britain's foreign markets, and were able to undersell her. The additional fact that many countries' exports were stimulated by inflation and aided by much lower costs of production was a further serious cause of the diminishing foreign market for Britain's export manufactures.

The War had given a decided impetus to the growth of certain of our basic industries, such as iron, steel, shipbuilding, and engineering; and their activities did not decline to any appreciable extent during the immediate period following the end of hostilities. In spite of the retrograde movement of the industrial export trade, Britain

enjoyed for a time a post-War boom. The basic industries prospered with four years' arrears to make up in repairs, replacements, and building of machinery, ships, and other constructional work used for peace purposes. In the atmosphere of "prosperity," and in anticipation of the economic and social conditions being rapidly settled, huge sums were sunk in the development of reconstruction work and schemes of all kinds; high prices were current, and wages out of all proportion to the wages of pre-War times continued to be paid; large orders for raw material in connection with reconstruction work and development of other schemes were placed abroad.

On account of the increased capital expenditure, in addition to high prices and high wages, the costs of production were considerably higher in Britain than in foreign countries. Industrialists had no alternative but to pass the cost on to the consumer at home and abroad. This practice failed seriously abroad, and the continued high level of cost of British goods put out of the question all possibility of retaining even a vestige of her former foreign market in the face of the diminishing prices of foreign competitors.

The psychological effect was apparent in the consternation and panic that accompanied this development. Orders for raw materials abroad were cancelled, reconstruction schemes were suspended, factories were closed down or put on short time, and capitalists were crippled or ruined financially in the ensuing dislocation of industry. Unemployment figures increased rapidly and labour troubles in strikes and lock-outs followed in quick succession any attempts made to reduce the rate of wages.

This was the state of affairs which ushered in the economic collapse known as the Slump of 1921. The industries which felt the worst effects and were rapidly reduced to a terrible condition of depression were of the basic kind—shipbuilding and engineering, coal-mining, and manufacture of cotton goods.

Pre-War Europe had supplied the rest of the world with

manufactured utilities in such constant and increasing quantity that the rest of the world was in a state of debt for portion of the goods. The War having drained Europe industrially was responsible for an opposite flow of manufactured articles, foodstuffs, and raw materials from the rest of the world into Europe. England increased her imports in 1920 from the level of 1913 by 100 per cent in foodstuffs and 70 per cent in manufactured goods. But England's superior commercial and banking position enabled her to meet her liabilities, while the rest of Europe was unable to do so. The volume of work diminished in industries; demand for raw material declined, and unemployment figures rose rapidly. The figures for the year of crisis 1921 in the key industries of crude steel and pig-iron gauge the position when world trade fell from the 1913 mark by 30 per cent.

MEAN PRODUCTION OF STEEL AND PIG-IRON
(Millions of Gross Tons)

Great Britain	Europe	U.S A.	Year
17·9	69·8	62·3	1913
6·3	34	36·3	1921

The crisis of 1921 became known as the great trade slump; it did not, as in the case of other past fluctuations of industry, carry within itself the seeds of industrial revival. It was corrected by external causes. Currencies were stabilized in Europe and the German War Debt was revised and merged politically into Europe's general indebtedness to the U.S.A.

RATIONALIZATION OF INDUSTRY

All industrial and commercial interests readily took advantage of the more settled economic conditions promised by the general return of currencies to a fixed standard.

The next important development in industrialism was rationalization of industry. Germany, after re-establishing her currency, led the way in Europe by adopting that policy, previously operated successfully by the U.S.A., of the wholesale amalgamation of similar industrial concerns, together with an intensive overhaul of the internal organization of her industries, with a view to obtaining maximum efficiency. Industrial Europe soon realized that the utilization of large-scale organization in buying raw materials, in the internal operation of various industries operating as one whole unit, and in sales control of different products, had advantages which led to considerably increased output and trade. The movement towards rationalization of industries, or formation of industrial combines, quickly spread, and the production of various countries greatly increased. National and international combines in industry were formed; profitable sale prices were maintained by limitation of output, which kept prices higher than was warranted by market conditions, thus tending towards increased production in all the industries concerned.

The Post-War Industrial Boom in the U.S.A.

In the United States rationalization of industries and methods had been proceeding at a rapid pace since the beginning of the century. In view of the magnified structure of machinery of production a special crisis had become imminent, and it was only the advent of the War in 1914 which averted and reversed its critical development. A phenomenal boom in industry occurred instead. After the War the U.S.A. found itself debt-free with a great importation of assets and gold which invested again outside the country brought it a steady inflow of dividends. There was danger that as an inevitable consequence a great army of labour would be unemployed because the favourable balance of payments took the form of an excess import of goods into the country. A post-War crisis was expected and

was suppressed only by industry being diverted into totally new fields of labour, which successfully harnessed labour-forces that otherwise would have been liberated. Intensive rationalization and cheapening of the product to the absolute minimum was the secret of the new industrial issue, with a secondary condition that the product should be that hitherto not accessible to the masses of the people, but possessing within itself a certain attraction for them. Four factors of fundamental importance appeared in the process—

1. Increased purchasing power through high wages absorbed much of the increased production.

This was made possible only by methods of rationalization.

2. Cheapening the product to a minimum by mass production.

3. Mass sales.

4. Gigantic advertising systems set up as an essential accompaniment to industrial technique.

The development of the motor industry solved the problem in part.

The motor industry received the lion's share of the expansion of industrial activities, but the associated industries and other enterprises followed hard on its track. A period of prosperity arose, and the years 1920 to 1929 marked an epoch of American industrialism in which everything flourished without halt. Public taste for consumption was encouraged, and its growth appeared phenomenal; and as it grew productive plant expanded more and more. The boom led to heavy speculation in securities. The new developments in rationalization and the enormous expansion of the instalment system, and the lowering of discount rates by the federal reserve authorities in the middle of 1927 had the important psychological effect of putting an unimaginable limit to the prosperity of the country. The stock-exchange boom was made possible in the early stages partly by bank credits. In 1928 the federal

reserve authorities had to counteract the excessive speculation—which by this time had sent the prices of stock-exchange securities up to phenomenal levels—by raising discount rates and by selling securities on the part of the banks. In addition to those required for stock-exchange speculation, large advances had been made by the banks for automobile and other industrial work. The change in the credit situation attracted money from other countries, especially for short term investments, and led to a heavy export of gold to the United States. The other banks, to prevent the flight of capital, raised their discount rates to meet that of the federal reserve banks. The restriction of credit slowed down to a certain extent industrial work, which indicated, in the middle of 1929, that the boom had reached and passed the peak height.

During the boom of prosperity the agricultural producers had followed in the wake of intensification of industry. Two tractors replaced fifteen horses, a modern harvester replaced 300 men. The production of wheat reached in 1928 30 per cent more than that of 1913. The American surplus of wheat, in value £59×10^6, was diverted to foreign markets and had to face competition from the improved agricultural organizations of agrarian countries, Canada, Argentine, and Australia, which were exporting about £235×10^6 worth of wheat. The rural population began to contract, and large numbers relinquished the land to take up industrial work in the cities. The proportion of the urban population of the United States rose to 64 per cent of the whole. It was only the artificial stimulus given to consumption by the instalment system that kept the inevitable check from the progress of industrial expansion, and rendered apparent a seeming absorption of fugitive agrarian workers. In fact, during the boom years 1923–28 the progress of mechanization was putting almost 15 per cent of industrial workers into the ranks of the unemployed.

Speculations soared and speculators had organized themselves into groups, but at the same time completely

ignored the fundamental fact that security prices should not have been sent to such phenomenal levels without taking any regard for their possible dividend yields. Quotations rose in September, 1929, on the average to about 344 per cent above the 1924 rates. Increasing attempts to create purchasing power destroyed it instead. The first signs of industrial and agricultural restriction of output proclaimed the signal of alarm in October, 1929. A sharp declivity of stock-exchange prices caused unfavourable reactions on other stock-exchange markets of the world The serious over-abundance of foodstuffs and raw materials caused wholesale prices to fall rapidly, and with alarming suddenness the whole security price structure collapsed even more violently than it was erected.

The following figures indicate the violence of the force that overturned a huge financial structure and brought down the whole world with it in its fall—

The money lost on stock-exchange values in two months amounted to about 100,000,000,000 dollars. The number of banks ruined amounted to 1300.

The course of industrial development under the aegis of a scientific industrial revolution for the ten years following the pricking of the bubble of post-War inflation was one of sensational progress in methods and technique of production; but it experienced during the same period a downgrade run of unparalleled magnitude. The progress of science in all branches of industry brought the technique of wealth production to a state of perfection, but the machinery for exchanging the products of the world's economic activity eventually failed to distribute the whole of its products among its final consumers at the right price.

The state of affairs affecting industrial conditions at the end of this period may be described succinctly as a crisis of super-abundance, in which industrial and agricultural

production heavily outbalanced consumption. The improved technique of manufacturing and the systematic methods of rationalization of productive enterprises led to the intensification of production which introduced new features into the general industrial organization and gravely disturbed the equilibrium between production and consumption.

The chief characteristics of the retrograde movement in industrial conditions manifested themselves in industrial depression, trade stagnation, and unemployment, and became first apparent in the industrial and economic system about the middle of until they reached at the end of three years a degree of exceptional severity. So vast became their extent that no country escaped the ravages of their influence or of their devasting effects, and so rapid was the development to a crisis that the situation went beyond the control of national policies. In emergency, a national parliament,[1] representing every country of importance met in the early part of 1933 in order to reach some decision to rectify and repair the effects of the crisis, but it failed to agree on a common policy.

Fig. 8 shows the contraction in world trade from 1929 to 1933 based upon the estimates of the trade of forty-nine countries representing about 90 per cent of the value of world trade. Fig. 9 illustrates the decrease in world industrial activity with the corresponding increase in unemployment figures.

The disastrous plight of world industry in 1933 was accentuated by the monetary and non-monetary economic conditions which were inextricably interlinked. "The monetary system failed to solve successfully a problem of unprecedented difficulty and complexity set it by a conjunction of highly intractable, non-monetary phenomena." [2]

The War may be said to have been a primary cause of a

[1] *World Economic Conference.*
[2] Macmillan Report, p. 93.

world industrial depression, but there are also aspects of a more general character that would, sooner or later, have produced an economic crisis. Without monetary disturbances there were forces in the agricultural and industrial spheres which were gathering momentum during the years before the War, and of which the resultant would have been a grave world economic crisis.

The economy of production within the industrial structure was threatened, during the post-War period, with serious dislocation because the various elements in its price regulator were out of harmony with one another. The economic rigidities imposed by post-War finance, economic nationalism, retail trade policy, trade unionism, etc., were at variance with its essential function. "Business cannot expand and the volume of production in general recover without substantial purchases of new capital equipment, and this will be deferred till the producers' goods become cheaper or consumers' goods dearer." [1]

In summing up, it may be said that the contributions made by engineering science directly resulted in the large-scale development of industrial production of the twentieth century. The introduction of innumerable new industries and more complicated trade processes brought such increased trade and a growing multiplicity of manufactured commodities that special problems came into prominence, such as employment of labour, more suitable sites and localizations, better lay-outs in plants, the necessity of still further reducing costs of production, the elimination of waste and the need for co-operation between Labour and Capital. In short, industrial administration became recognized as being a complete science in itself.

The problem of adapting the basic industries in Great Britain to new conditions dates from before the War. Much has been done since in bringing organization and plant up to date and increasing the scale of production to meet the

[1] *Vide* J. Johnston, *Journal of the Institute of Bankers in Ireland*, April, 1933, p. 99.

stress of foreign competition. The process of adjustment has, however, been seriously hampered within recent years by the prevailing depression and the difficulty in finding the necessary capital.

"The ability of the British iron and steel industry to retain its place as one of the leading iron and steel industries of the world will be conditioned by many factors, but perhaps, above all, by its power to enlist men of inventive genius as well as men of outstanding capacity as organizers. For a very long period the great discoveries relating to iron and steel technique were to a remarkable extent the work of British iron and steel industry. It is for the industry to make sure that it possesses men of the necessary calibre, who will be able to reassert in the future the position of the British industry as a leader among the iron and steel industries of the world."[1]

[1] Committee on Industry and Trade, *Survey of Metal Industries*, pp. 9, 10.

PART II

CHAPTER IV

THE STRUCTURE OF MODERN INDUSTRY

IN analysing the structure of the productive system, modern economists distinguish four factors in production—land, capital, labour, and organization—and in economic theory this gives us a fairly clear-cut division. The reward for economic activity is money-income and our productive system is therefore a price system. When we endeavour to segregate the receivers of money-income into classes corresponding to the fourfold division, we find not only overlapping, but also classes that are not covered at all. Rent usually contains a greater or smaller element of interest: interest includes usually a payment for risk-taking and an element of profits. Organizers, and even the workers, contribute part of the capital, while the professional classes and others rendering personal service cannot be regarded as belonging to either the organization or labour groups.

THE INDUSTRIAL STRUCTURE

For the present purpose, however, we may regard the whole population simply as producers and consumers. Not as two separate *classes*, for here again there would be overlapping. All producers are also consumers, and most consumers are producers. It is better to consider the people in their *capacity* of producer and *capacity* of consumer, so that we can get some idea how the first reacts on the second.

Our economic system has been described as a price system, because its working hinges on the obtaining and the spending of money-incomes. The earnings of industry supply the means of subsistence to the people, in the form of wages for labour and services, remuneration for skill, or interest on income saved and invested as capital. The social condition

of a people, therefore, depends in the long run, and to some extent in the short period, on the prosperity of its industries. Human effort commands a price—depending both on its quantity and on its quality—in the labour market, and this price is paid in wages or salaries. Material, lands, property, capital, businesses, and goodwill have all got their market prices. The price indicator influences the human agent in deciding what to produce, and how it is to be produced: it determines the contraction or expansion of production, and decides whether factories shall work overtime, short time, or shut down altogether. Price also regulates consumption, and to some extent prevents exploitation by the producer, but the weakness of the system lies in the fact that prices do not always truly represent the real needs of society; and where this happens there is serious loss both to producers and to consumers.

Exchange presupposes the rights of property in the things exchanged. The modern industrial system, which is largely the product of the Industrial Revolution, assumes the existence of private property and the right of freedom of enterprise. It is capitalistic in character, and developed its chief features in an atmosphere of individualism, within a competitive framework.

Factors Making for Change

One of the axioms on which the whole of political economy is based is that man always seeks to obtain the maximum amount of satisfaction with the minimum amount of effort. It is this motive which lies behind the constant striving after "economies" in economic life. It is manifested in the efforts of the entrepreneur to obtain greater profits, in the struggle of the workers for a higher standard of living, and in the desire for greater material welfare on the part of the whole body of consumers.

The desire to minimize the effort required to satisfy a want, or to secure a greater total of satisfaction with the same effort, is a potent factor in altering the industrial

structure. The isolated labours of individual workers are replaced by organized and unified effort, embodying the principles of the "division of labour": operations involving intense physical effort are made easy by the invention of machines which relieve the muscular strain: the making of individual articles is replaced by the manufacture of standardized parts, which facilitates and multiplies production; and throughout the whole economic field the same underlying motive is constantly making for change.

As the accumulation of capital increases, plant and equipment are improved; as we advance in knowledge, improved technical processes and methods are discovered; as the volume of production increases, changes in organization take place. Changes in government policy, in methods of distribution, in the relations between Capital and Labour, may all affect the industrial structure. The structure of industry is therefore by no means "static." Our industrial organization is changing, though neither the form nor the rate of change is uniform. Some features are developing more rapidly than others throughout the industrial world; though even in this respect the rate of progress varies in different countries. We must realize, therefore, that we cannot depend on the permanency of the various features of our industrial organization as it exists to-day.

Geographical Specialization

One of the characteristic features of modern industry is the tendency toward specialization—both regional and productive. After 1850, when other countries followed our lead in industrial development, regional or territorial specialization grew rapidly. Differences in natural resources, in climate, and in the aptitudes of the people led to the specialization of the industries in new areas, intensified the economic life of districts already specialized, and yielded great economies in production. Consequently, there was a tendency for special areas to concentrate more and more on a limited range of industries with products

intended for world-wide distribution, and hence transport facilities were a determining factor.

As a result, Britain found herself with industries highly specialized in respect to geographical distribution. Her industries had developed during the period when charcoal had been displaced by coal in the smelting of ores, and when steam power was the keynote of industrial progress. Most of our coal-fields were near to the sea; our staple industries were dependent on foreign markets; and important raw materials were imported. Proximity to coal and proximity to sea-ports were therefore controlling factors in the choice of industrial sites. The result was a shifting of the industrial centres, and their concentration in the neighbourhood of coal-fields, and, more particularly, in the neighbourhood of sea-ports. The development of this geographical specialization was a characteristic of the nineteenth century, and applied, not only to the great staple industries, but to others, such as pottery, glass, and chemicals, in which coal was an important element in the cost of production. Particular branches of the staple industries concentrated in particular areas. The "internal" and "external" economies resultant from a highly localized industry strengthened this tendency to specialization, so that in many centres, such as Glasgow and Durham, other industries decayed through concentration on the more profitable specialized trades.

The tendency for industrial concentration in the coal areas was already weakening in the years preceding the War. The staple industries were, indeed, not much affected by the movement, as there were in them several forces which operated to preserve the predominance of the old industrial centres—

1. The factors of "inertia" and of proportionately large "sunk" capital combined to resist change.

2. The facilities of banking, organized commerce, and transport in these areas had been designed and developed to meet their needs.

3. They were already favourably situated with regard to supplies of raw material and to supplying foreign markets.

So long—and just so long—as their exports continued to expand, or at least did not decrease, their position was comparatively secure. But technical changes in these industries were, in many cases, destroying the relative advantage which Britain possessed over other producing areas; the world demand for certain classes of materials we were best fitted to produce was changing in favour of materials in which we had no advantage, or less advantage; the development of home production in some of our foreign markets; the rise of new producing centres, equipped with factories of the most modern design, and with the latest types of highly specialized machinery; and the ever-increasing tariff barriers, all were factors combining to reduce the relative foreign demand for the products of our staple industries. The post-War depression saw a serious reduction in their exports, and as the years have passed it seems more and more certain that they can never regain their pre-War rate of expansion, and that many of them will not again reach the 1913 standard of production.

Decentralization

In other industries the advantages of localization were nullified by factors which favoured a policy of decentralization—

1. The development of other forms of power—and particularly electric power—as well as the development of less wasteful methods of using coal itself, made proximity to coal-fields a factor of less importance in the selection of industrial sites.

2. Increasing costs of ground rents and heavy local taxation tended to drive factories from industrial cities to the suburbs, to country areas, and to smaller towns.

3. The development of transport permits workers to live much farther from their work-place. Manufacturers can therefore draw their workers from a wide area.

4. Improvements in the technique of industry have replaced the highly-skilled worker by the semi-skilled machine "minder," and have made employers independent of the localized market for highly-skilled workers.

5. Just as the desire to be free from traditional methods was a factor in the establishment of new industrial areas in the early period of the Industrial Revolution, so the new industries prefer new areas where labour is considered more manageable and less opposed to a new technique.

6. Proximity to markets and distribution centres had become in many industries more important than proximity to raw materials.

Industrial Specialization

These forces have operated very strongly in the newer industries, such as the production of motors, gramophones, and artificial silk, which developed in the southern and midland areas of England. These areas have developed considerably in the industrial sense, especially during the last decade. The northward movement of industry which marked the industrial revolution in Great Britain seems now not merely to have been checked but to be reversed, so that the current of industry is moving southwards. Thus, in contrast with the trend of industry in the nineteenth century to concentrate near the coal-fields, there is now a movement towards decentralization; and it is worth noting that decentralization is a marked characteristic in the new industrial development of the Irish Free State. One important result of this policy may be noted. The development of new industries might have lessened the effects of the increased unemployment, caused by the decay of the staple industries, provided both were localized in the same areas. But while there was serious unemployment among juveniles in the North, and in South Wales, owing to the stoppage of labour recruitment in the staple trades, there were periodic shortages of juvenile labour in the Midlands and South. Thus, the movements of the newer

industries away from the old industrial areas has contributed to the complexity of the unemployment problem by adding to the mal-adjustment of labour.

While regional specialization was a comparatively early feature in the development of modern industry, it was only in the latter part of the nineteenth century that conditions also favouring industrial specialization came into existence. The development of mechanical transport and the cheapening of freights made our markets world-wide. The mechanization of agriculture in Europe and the Middle West, and the use of labour-saving machinery in the basic industries, greatly increased production. Specialization requires a steady mass demand, and this the wider markets supplied.

An establishment with unspecialized machinery and processes produces a commodity in diverse varieties. The loss of time in production involved in changing from one pattern to another, and the inability to use specialized machinery economically, keep production costs high. It must look for its profit to higher prices due to the number and variety, the attractiveness and convenience of the designs, rather than to low production cost.

On the other hand, a business specializing in the production of a single article of standard pattern which is in wide demand looks for its profits to lowered production costs. Costly labour-saving plant can here be installed, because it is anticipated that the market will absorb a volume of output sufficient to keep the plant in more or less continuous operation.

It is obvious that a change-over from unspecialized to specialized production involves heavy capital expenditure. To secure the full economies of specialized production requires a process of continuous production, with the subdivided operations performed by semi-automatic machinery and an enormously increased output. Under highly competitive conditions in an old-established industry, a firm will not usually risk the heavy capital outlay involved

in specialization. They would have to scrap their existing buildings and machinery, except where thoroughly adaptable, and erect new buildings on the largest practicable scale, equipped with the most up-to-date machinery and labour-saving devices; and reorganize their whole productive system. It is mainly for these reasons that Great Britain, in some of her old-established industries, has not developed specialization to the same extent as some of her foreign rivals, who came much later into the production field. Specialization is therefore usually developed in new industries, or in established industries, either by new firms or through the amalgamation of a number of firms producing related products. Specialization is usually found in conjunction with "large-scale" and continuous production, as the latter are needed to realize the economics of the former; and it is to the economies connected with these that we owe the steadily increasing size of the average producing firm, which is such a marked feature of the modern epoch.

Economic Freedom

The transition from small-scale to large-scale production has resulted in fundamental economic changes. In an industrial society based on small-scale production a period of depression is accompanied by drastic wage reductions, and the failure of some of the less efficient firms. This process of "healthy bankruptcy" helps to remove the surplus capacity for production in the affected industries and makes possible a rapid recovery. In a system of large-scale production, on the other hand, the proportion of fixed capital in the producing units is invariably large. Fixed overhead expenses are therefore heavy, and persist even if production ceases. As long, however, as the selling price of the product is sufficient to cover the manufacturing cost, and leave a small margin towards the "overhead," the total loss sustained will be less than that occasioned by shutting down. Further, since each unit of production contributes a

fraction towards "overhead," the larger the production the less will be the total loss. In a time of depression, therefore, such firms often endeavour to cover their overhead charges by maintaining production at low price levels. As the volume of output is not appreciably reduced, the disproportion between price levels and costs tends to continue, and thus retards the process of recovery.

In this way our economic system has become more rigid, in that it is less responsive in adjusting itself to meet changing conditions. The same thing is seen as a result of the increased specialization and standardization in large-scale production. A plant producing a wide range of products with unspecialized machinery can readily adapt itself to changes in demand. A plant with specialized machinery, producing standardized goods under large-scale methods, is designed to meet a stable demand. It cannot readily adjust itself to changes in demand, which can only be met by radical alterations and reorganization of plant and process. A striking example of this is given by the case of the Ford Motor Works, which was compelled to shut down completely for several months in 1927 to prepare for the production of a new model.

During the past twenty years productive efficiency has been considerably increased by changes in technique and organization. The scarcity of labour during the War stimulated the adoption of labour-saving methods. The intensity of competition has increased the tendency to develop large-scale production methods and secure the economies arising from the application of scientific technique.

In the case of individual firms, these changes have resulted either as part of the natural evolution from the handicraft stage to mechanical methods of production, or as part of a deliberate policy to secure more economical production. In the case of combinations or trade groups they are usually a part of the wider policy of rationalization.

Formerly, a change of this kind could take place in a firm, or even in an industry, without making its influence

felt beyond its own immediate circle. Nowadays industries are brought into much closer relationship with each other by technical, economical, and financial causes, so that new *productive methods pass rapidly from one to the other.* An improvement in technique in one industry may have a practical application in another. The adoption of standardization and large-scale production methods in an industry may require the standardization of subsidiary trades. A subsidiary trade thus standardized may supply components to other industries, which in turn tend to adopt large-scale production methods.

One of the consequences of the improvements which have been made in industrial technique is the rapidity with which increased demand can now be met by increased productive capacity. Where industry is organized on small-scale production lines, an increased demand is met by an increase in the number of producing firms. The tendency here is for the productive capacity to lag behind the demand. Under modern conditions of large-scale production when an expansion of demand takes place, productive capacity can be quickly and greatly increased. There is a considerable danger, however, that this capacity may become excessive. Whereas the increased productive capacity required by society is determined by economic considerations, the actual increase is usually determined by technical considerations. The former may justify an increase of 30 per cent in capacity, but the latter may require a 50 per cent increase if any. Capacity may be quickly increased, but it cannot be rapidly reduced. Excess capacity may result in over-production; and produce a severe depression, as happened in the case of the artificial silk industry in Great Britain and the motor industry in the United States.

While changes in technique are of the greatest importance in effecting alterations in the industrial structure, a change of another and more fundamental nature has been taking place, which has radically altered our whole economic

structure; and that is the movement towards combination which has practically destroyed the competitive basis of industry. A fundamental feature of our modern system is the large measure of economic freedom it confers on the individual. With comparatively few exceptions, each producer has complete freedom of choice as to the branch of business or production in which he will engage. If he intends setting up business on his own account, whatever his lack of technical qualifications may be, he may start a linen factory, a shipbuilding yard, or even a bank, provided he has or can secure the necessary capital. The same applies in the case of the wage-earner. With the decay of the apprenticeship system the only restrictions imposed on those seeking to enter a trade are those which the trade unions are able to enforce.

The unrestricted exercise of this right would inevitably result in chaos, as the vast majority of people would desire to enter the most pleasant, easy, and remunerative occupations. There are, however, several factors which operate in restricting this freedom of choice. It is obviously in the interests of the community that each individual should produce as much wealth as possible. Since individuals have different aptitudes and powers, there is usually for each of us some one task which we can do best. The fact that we do not always find that task is partly due to our system of education and partly to the conventions of our environment. There are many "square pegs in round holes." But in so far as we do find the work for which we are best fitted, that work is likely to be most remunerative to us, and most beneficial to the community. Furthermore, in proportion as competition is active, each individual will tend to engage in that occupation for which he is best fitted, taking into account the needs of society.

But while the individual has thus, in theory, full freedom of initiative and freedom of contract, he finds that in practice this economic freedom is very much circumscribed. The development of modern society has so

increased the interdependence of individuals that the actions of one interlock with the activities of others. In industry, therefore, there is not freedom of action. From the building of the factory to the sale of the finished product, the entrepreneur finds his freedom of action continually hampered. The plans for his buildings must conform to the requirements of the local authority, and his finished premises must pass their inspector. Requirements as to the cubic air space per worker, sanitation, the fencing of machinery, and other matters are prescribed for him under the Factory Acts. The conditions of work and the rates of wages of his workers are fixed for him under trade-union agreements; and his power to transfer men from one task to another, or to use particular men for certain machines, is restricted by the custom of the trade or by union regulations. The price he pays for his raw materials is determined by the competition of his rivals, in so far as it is not fixed by producers' agreements. His volume of output, conditions of sale, and even his minimum selling price may be fixed for him by the cartel or ring which he has been forced to join for self-protection. The level of prices on which his production has been based may be altered through the policy of the Government and the banking system, so that his selling price may, on the one hand, be much higher than anticipated, or, on the other, may not cover his expenses of production. In short, his whole industrial activities now depend so much on the actions of others that a wide knowledge of life, and of the economic principles which govern the affairs and actions of men, are essential for industrial success.

The Competitive System

The competitive system, in spite of its obvious defects, has many advantages. The spirit of emulation is inherent in human nature. Competition utilizes this as an incentive to stimulate initiative, and to force producers to exercise their fullest energies, so that society obtains the

maximum production of wealth. It is through competition and bargaining in the open market that prices are fixed, and the business man looks to these prices as a guide to what the public demand. Through the price system, also, competition prevents to some extent the exploitation of the consumers. It metes out a rough measure of economic justice, so that each individual tends to be rewarded in proportion to the measure in which his products or services have contributed to the public wants. Competition acts steadily towards equalizing the remuneration which can be obtained for equal ability in each stratum of society. It also constantly tends towards establishing an equitable ratio between the remunerations obtainable in different strata. And, above all, through competition, the distribution of the national dividend is automatic, industry and trade are carried on by private initiative, the Government acting in a regulative capacity only.

The competitive system is, however, by no means as perfect, or as impervious to criticism, as the classical economists would have us believe. It has many evils, most of which have developed through the operation of uncontrolled private enterprise. Competition is based largely on the motive of self-interest, and in some cases tends to bring out the baser and harsher aspect of human nature in business dealings. It has led to the sacrifice of public welfare to private gain. Increased sales at lower prices may mean larger profits; but how often are these obtained through the substitution of inferior quality of materials? It is to competition we owe the adulteration of foods and the sale of shoddy materials. In short, competition in its worst forms blunts the finer moral sense and lowers the standard of business morality.

The competitive system is wasteful along many lines—

(*a*) In the development of the newer countries forests, minerals, and other natural resources have been pillaged under the stress of competition, without any regard to conservation.

(*b*) Where production is carried on by competing units, each entrepreneur tends to produce the maximum amount which he believes the market will absorb from him. He may be able to gauge fairly well how much goods the market can absorb at remunerative prices, but he cannot know the amount of output that will be placed on the market. Just as he keeps his own plans secret, so he is in ignorance as to the production plans of his rivals. The index on which he mainly relies is that of market price, which is not a reliable barometer in that the fall takes place when the market has already been glutted. It sometimes happens, therefore, as a result of this unco-ordinated production, that a larger aggregate of the products of that industry is produced than is required.

(*c*) When there are several competing firms covering the same field, as is usually the case in the distributive trades, the aggregate wastage is enormous. For instance, one road known to the authors contains about thirty houses which are served by seven milkmen and six bakers. The existence of such superfluous firms helps to swell the margin between the price the producer receives and what the consumer pays.

Where competition results in bringing goods to the market at prices lower than the public would otherwise have to pay it acts for the benefit of the consumer. It may lead to the lowering of production cost through improved organization, and to increased demand through a cheapening of the product. In modern times, however, we must discard the view that good service and low prices can always be secured by the pressure of competition. Competition does not necessarily guarantee reasonable prices. Keen competition often increases considerably the expenses of distributing commodities. Where an increased number of competitors share a fixed volume of trade, the additional charges may actually increase instead of lowering the price.

Whatever clash of interest there may be between producer and consumer in a system based on free competition,

the combination movement, in so far as it is monopolistic in character, presents an even more serious conflict.

Combination

The principle of economic freedom which lies at the root of individual enterprise and the competitive system, involves the right of freedom to combine. Wearied by the intense and constant competitive struggle, individuals guided by the principle of self-interest have endeavoured to eliminate or modify the worst features of the system by means of combination.

Just as in competition there are many different forms, ranging from friendly emulation to ruthless and destructive rivalry, so the various forms of combination range from the loosest types of agreement to the closest trust.

There are several ways in which combination is brought about. In some cases, after a severe competitive struggle in which the weaker firms fall by the way, the surviving firms, worn out by the struggle, come to an agreement in the interests of self-preservation as to conditions of sale, prices, and output. A man of outstanding ability in charge of a large business, seeing the advantages which accrue from continuous mass production, engineers an amalgamation with competitive enterprises in the same line of production, thus expanding horizontally. Or again, a firm in one stratum of production, desiring to free itself from dependence on the producers of raw materials or the sellers of finished products, may, by amalgamation, expand vertically through other strata. Many combinations, both of the horizontal and of the vertical types, were formed in the United Kingdom between 1914 and 1920. In some of these, it was not realized that amalgamation is only the first step in industrial reorganization. This must be followed by internal measures to remodel the industry on lines that will give increased efficiency combined with lower costs. Without this, they were not framed to weather the storm which followed the break-up of the post-War boom, and so

collapsed. Others survived, and the tendency towards combination has strengthened during the past decade.

The desire to control output and prices was the main motive in these combinations of the horizontal type, and also in the numerous cartels and price associations spread over the whole industrial field, while the vertical combinations were actuated by the desire to secure markets and supplies of raw material.

Combinations are known by various names—pool, combine, association, community of interests, ring, corner, conference, amalgamation, trust, cartel—and it is sometimes difficult to distinguish one type from another. Roughly, they may be classified as belonging to either the "trust" or "cartel" type. Even here there is a difficulty, because we cannot apply a fixed meaning to either of these terms, and sometimes they are used as if they were synonymous. The chief distinction between the two forms of amalgamation is the degree of independence retained by the individual units forming the combine. In the trust there is complete fusion of the amalgamating firms; the individual units are assimilated in the new entity, under one centralized control. All functions are exercised by the central body, even though the original units may continue to exist under the old name as separate bodies in the legal sense. In the cartel the separate firms remain as independent enterprises; certain functions such as fixation of price or limitation of output being vested in the central body.

The trust aims at securing all the economies of continuous mass production, through unification of effort, centralization of control, more perfect organization, greater efficiency, and lower production costs. The cartel gains none of these economies, as the individual firms work independently on the same scale as before. It aims mainly at the abolition of outside competition, and the fixing of an artificial level of prices for the preservation of weak firms; and in this way it is a hindrance to progress. From the consumer's

point of view both forms are to be feared. The cartel exists for the purpose of keeping prices above the normal. The trust is in a position to reduce prices, but it may not do so. The tendency of both is to increase profits at the expense of the consumer.

RATIONALIZATION

The endeavour to secure economies in production, though evident in all combinations of the trust type, has been considerably emphasized in the movement towards rationalization.

Rationalization means "the methods of technique and organization designed to secure the minimum waste of either effort or material. It includes the scientific organization of labour, standardization of both material and of products, simplification of processes, and improvements in the system of transport and marketing."

The rationalization of an industry involves—

1. The conscious and deliberate planning, not of individual enterprises, but of the industry as a whole.

2. The amalgamation or unified control of individual enterprises, with the elimination of weak and inefficient units, so as to secure control of the market.

3. The closing down of redundant mills and factories to eliminate excess capacity, waste, and loss.

4. The scrapping of obsolete buildings and machinery, and their replacement by others designed to secure the highest efficiency.

5. The specialization of plants, with each planned for continuous mass production, and equipped with specialized machinery so as to give the maximum economies.

6. Conservation of raw materials and power.

7. Centralized control of distribution, to obviate unnecessary transport, burdensome financial charges, and the useless interposition of middlemen.

According to Professor Clay, rationalization consists of "industrial combination with the object of securing, not

monopoly prices, but certain productive economies." Unfortunately, some industrial firms and financiers have carried through combinations aiming at monopoly prices or "promotion" profits under the guise of rationalization. In some of our great British industries there have, however, been real attempts at rationalization. It has been carried out in the cotton industry to reduce excess capacity, lower production costs, and improve methods of marketing. The iron and steel industry also aims at reducing excess capacity and at the same time securing the economies of continuous mass production by great integrated combinations in each district. In the rapidly expanding chemical industry, the aim has been to secure the economies arising from large-scale production and organized research.

We have been considering combination chiefly from the national point of view. Owing mainly to increasing tariff barriers, there has been a growing tendency for combinations to overstep national boundaries and become international in character. Though some of these are of the trust type, as, for example, the European Linoleum Trust, the vast majority are, like the International Steel Cartel, "international industrial agreements" of the cartel type. Such agreements have been formed in the steel, non-ferrous metal, potash, oil, aniline dye, and electric lamp industries. They generally provide for the retention of "home" markets, and the allocation of exports in agreed proportions, while they sometimes also limit and allocate the amount of output of the participating countries. By these measures, industrial firms are endeavouring, by international agreements, to overcome the depressing influences exerted on trade by national political policies. From the social point of view, it is claimed for combinations and international agreements that by their control of output they adjust supply to demand and thus lessen the severity of the trade cycle. The Economic Committee of the League of Nations support this view, and consider that they have tended to bring about a greater degree of price

stability than would otherwise have existed. But it may be urged against this that their maintenance of prices during a period of falling costs helps to create conditions favourable to a depression. It is said that combination eliminates the evils of competition. But they do this by substituting a special form of competition for a general one. On the other hand, it is argued that combinations can become so wealthy and powerful that they get beyond the powers of State control, and use their power autocratically for their own advantage.

None of these claims for or against combinations can be taken as proved. But, whether they are beneficial or injurious to society, we must accept them as part of the industrial structure. There are, of course, certain types of industry in which monopoly must predominate, as in the case of the supply services, such as light and water. In such cases, monopoly, so far from being a danger, is in the best interests of the consumer. Investigators like Mr. Cutforth and Professor Macgregor have clearly shown that in our own country the large amalgamations have, on the whole, been beneficial to the community, in that they conduce to stability of prices and that the interests of the consumers have not suffered. Whether or not this is due to the fact that such amalgamations possessed only a partial monopoly is beside the point. There are many examples in which the interests of the consumers have been sacrificed for higher profits; and the worst features of unscrupulous and ruthless competition have appeared in the endeavour to secure and maintain monopolistic control, and destroy the open market.

Combination, particularly on rationalization lines, permits of important economies. There is, however, the danger that no part of the gain may pass to the consumer and that monopoly power may keep up, or even increase, prices in spite of reduced costs, as happened in the case of the petroleum refining and tobacco industries.

Whether combinations in general have, or have not,

unduly raised prices, they have, at any rate, the power to do so, and for this reason they are a *potential* danger to society, unless subject to control in some form.

Industrial Administration

The nineteenth century was intensely individualistic in character, and that principle largely moulded the structure of our industry. Right up to the end of the century the typical industrial concern was controlled by individuals or partners who themselves owned the capital. In the early part of the century, the methods were largely those of trial and error, and success depended rather upon native shrewdness than on systematic knowledge. The owner of a business prided himself on being a "practical" man, and his methods were largely those of "rule of thumb." The application of engineering principles to industry changed all this, and brought to industry that exact knowledge derived from systematic training. Industry on its technical side developed new standards as to accuracy and exactness of knowledge, new conceptions of law, both natural and economic, a realization of the value of records and standards, and new ideas and practice of the co-ordination of functions. The amazing improvements in industrial technique arising from the application of scientific principles naturally excited a demand for a corresponding development on the administrative side.

So long as we were accustomed to think of industry as under the control of owner-managers we were liable to confuse the art of administration with the "profits" of the capitalist and the "risk-taking" of the entrepreneur. While we have readily recognized that the development of the factory system resulted in the separation of capital and labour, we have been much slower in perceiving that the same force is separating the capitalist from the administrator. The rise of the company form of organization has, however, rapidly resulted in a distinction between these functions.

The ordinary shareholder in a limited company exercises very little control over the policy of administration. He has a voice in the appointment of directors, who put matters largely in the hands of the managing director. He, again, delegates various administrative functions to his managerial officials, who in turn delegate their authority down the administrative line. In great company concerns, therefore, we have three distinct groups of interests—the investors who own the capital, the workers who perform the labour, and between these the administrative body. We can here perceive that the function of administration differs essentially from that of capital.

Through the work of earlier generations our age has come into possession of such an enormous accumulation of wealth, and such wonderful and powerful agencies of production, that the problem of their administration in the best interests of society is a vital one.

While industry was still in the owner-capitalist stage, business administration was a private matter which concerned only the individual firm. When industry reached the joint-stock company stage, with its capital subscribed by the general public, business administration became an art of great social importance. Up to the present, the administrative group have considered themselves, mainly, if not solely, as the representatives of the investors, and hence adopt the traditional capitalistic attitude. In course of time they will realize that they exercise an independent and distinct function with a threefold responsibility. The administrator is, at one and the same time, the trustee of the property of the shareholders, the guide and instructor of the labour force, and the guardian of the interests of society. When this is thoroughly realized, business administrators will formulate principles and standards of a purely administrative character; and just as the technical expert applies the principles of science to control the industrial processes, so the administrative expert will utilize the underlying principles of human nature to guide

and control the human factor in production. When the science of administration has reached its full development, the administrative body, while safeguarding the interests of investors, will so direct the process of industry that it best serves the interests of society, and at the same time is most conducive to the welfare of the labour force.

The Interests of the Consumer

But that day is not yet. Meanwhile, in the pressure of personal interests, we seem to have lost sight of the fact that the production and distribution of goods are only a means to an end—the satisfaction of the wants of consumers. The consideration of paramount importance is that society should obtain the maximum amount of the goods and service it requires at the minimum cost. The whole process of production should be directed towards securing that end, and the interests of production should be subservient to those of consumption. Since, however, the interests of the producers lie in securing the greatest value for what they produce, they come in conflict with those of society as a whole, and the problem is further complicated by the fact that the producers are themselves consumers. In the keen competitive struggle which marks our era, the *end* seems to have been sacrificed to the *means*; the interests of the consumers have to a great extent been disregarded, except in so far as they are the ultimate purchasers. The working out of the Five Years' Plan in Russia has given us an example of the utter disregard for the interests or wants of the consumers, with which an organized plan of production may be pursued. While other countries have not reached the stage of deliberately ignoring the welfare of society, yet in so far as they make production interests paramount, they achieve the same result.

The competitive system, in spite of its many imperfections, did, to some extent at least, protect the interests of the consumer. But conditions have now altered so greatly that an example of perfectly free competition between

business units is rare. There are still some markets in which competition is the keynote. For the most part, however, the whole competitive structure is permeated by monopoly. In many cases the boundaries between them are indistinct, as they shade into one another so gradually. It is not clearly realized to what an extent free competition has been displaced. In addition to the whole series of trade combinations already discussed, there is the whole co-operative movement; "competitive" firms are dominated by numberless trade associations controlling prices; while "independent" companies and firms are interlocked by share-holding in various forms.

With the disappearance of free competition the automatic controls which it exercises also disappear. Under a system of association or combination of producers, there is nothing to replace these controls. We require new machinery, specially adapted, on the one hand, to ensure the economies resulting from planned and organized production, and, on the other, to safeguard the interests of society at the least to the same extent as under the competitive system.

What is to be the nature of that machinery? We may perhaps expect that the growing spirit of association among producers will lead to the development of self-government, in order that their own interests may be safeguarded. But can we anticipate that such self-government will so guide and direct productive energies as to develop the ideal of public service, and a sense of responsibility to the community at large?

We are afraid that this is too much to expect of the near future. Shall we find instead a new development of consumers' associations, striving to force on producers the ideal that the sole aim of production is to increase the satisfaction of consumers? Though individual consumers may have recognized the necessity of combining in defence of their own interests, there is little evidence of movement in that direction. Some economists have suggested a

return to the ideals of *laissez-faire* as a cure for the evils of the present situation. But the competitive system, owing to its imperfections, carries in it the seeds of its own destruction, and it is now generally recognized that neither the trend of thought of modern society nor the structure of modern industry and finance are compatible with free competition.

State Control

There remains then only the State. In the matter of State control we have travelled far from the position of the early nineteenth century, when it was held that the less the State interfered in the economic system the better. In nearly every country the State now undertakes the provision of various services, and in some cases it takes part directly in industrial production. It facilitates production and exchange through its consular services; it sets up administrative boards to conduct semi-public enterprises or commissions to investigate problems of industrial or commercial interest; and it enters into international trade agreements. It is only a further step to suggest that production should be "managed" in the interests of society at large, just as the currency may be "managed" in the interests of a staple price level. Where State intervention is necessary in industry, its chief aim should be the maintenance of competition on a higher and more wholesome level, by regulating the ethical basis on which it is carried on.

But the form in which control should be exercised presents a serious problem. There are, of course, those who urge a widespread advance by the State into direct industrial production by a policy of nationalization, on the ground that private capitalism cannot be compatible with a planned economic system. A modified form of nationalization suggests the taking over of industry by a public corporation which does not work for profit but for a fixed rate of interest on capital. It is interesting to see in this

connection the recent development in Italy, where the State has been authorized to invest in the shares of private companies, and to guarantee both the capital and the payment of a small rate of interest on the capital of such concerns. On the other hand, many consider that nationalization would be a disastrous policy, and that State "management" of industry should be confined to the planning of organization and to the manipulation of finance. Again, while some would apply State regulation to all the national economic processes, others would limit its operation to particular functions whether national or international. It is here that a sharp line of division is taking place. In some respects the economic structure of industrial countries is becoming more and more centralized on national lines; in others it is becoming more international in character through the international fusions of great industrial combinations with their ramification of "agreements" and "understandings." The attempt to set up a planned national economy in a country such as ours, dependent on world markets and international finance, is attended with grave dangers both political and economic. Previous efforts to manage industries, nationally or internationally, have been made so crudely and badly that they have done more harm than good. To try to maintain the price level of a commodity irrespective of changes in demand or in costs, or to retain a fixed wage level in spite of a heavy fall in prices, is injurious both to industry and to society. One of the root causes of the world's troubles to-day has been the growth of economic nationalism. Any organized national planning for industry which aims at improving the relative competitive power of a country may temporarily increase the evils it hopes to avoid. The "internationalization" of industry is free from these defects, though it possesses other potential dangers from the possibility of monopoly.

In times like these, with such rapidly changing conditions, it is necessary that we should have a definite and far-sighted economic policy, framed by experts and capable of

rapid adaptation to meet changing circumstances. The appointment of an Economic Advisory Committee for the United Kingdom in 1930 gave some grounds for hoping that the powers that be had at last realized the urgent necessity. It is to be feared, however, that the movement towards a "managed" industry, whether springing from the State or from individual industries, is more likely to develop piecemeal as the result of external and internal pressure, than to develop along definite lines as the result of preconceived principles and a planned policy. But however it comes, it seems that increased State regulation is inevitable. The extent of that regulation depends internally on the development of the ideal of public service in industry; and externally on the intensity of the conflict between economic nationalism and international industrial combination. The interaction of these forces will decide the nature of the industrial structure of the future.

CHAPTER V

THE FINANCING OF INDUSTRY

SINCE the methods of financing an industry depend to some extent on the form of organization of the industry, it is necessary that we should first consider different types of organization assumed by individual industrial units.

TYPES OF BUSINESS ORGANIZATION

Industrial and trading enterprises carrying on business under ordinary competitive conditions may be classified as follows—

(*a*) Sole Traders.
(*b*) General or Ordinary Partnerships.
(*c*) Limited Partnerships.
(*d*) Public Companies.
(*e*) Private Companies.

Sole Trader. A sole trader is one who carries on business on his own account and at his own risk. This is the simplest form of business organization. The owner takes an active part in the control and management of the business. Profits or losses are borne directly by the employer. This type is predominant in the retail and small manufacturing businesses. The advantages lie in the personal supervision and attention to detail which can be given by the owner. Its chief defect lies in the unlimited liability of the owner, whose personal fortune is liable to meet deficiencies arising from trading operations.

Partnerships. A partnership is defined by the Partnership Act, 1890, as "the relation which subsists between persons carrying on business in common with a view of profit." A partnership may not consist of more than ten persons for the purpose of carrying on the business of banking or, in case of any other partnership, of more than twenty persons.

The partnership form of organization is suitable for wholesale, retail, or manufacturing businesses where a larger amount of initial capital is required than can be supplied by a single individual. With this form of organization, talents can be made to conform to functions and the partnership framed to include a person capable of dealing adequately with each important phase of the business. Thus, a partnership in a manufacturing business might well include a technical expert to plan and supervise the processes of manufacture and look after equipment; an individual capable of supervising finance and accounts; a selling expert with a good knowledge of the market; and a general executive, capable of dealing with questions of general policy and of keeping the general lines of specialized effort in due proportion. From the point of view of initiative and enterprise, a partnership is an ideal form of organization. It suffers, however, from the handicap of unlimited liability, since every partner is liable jointly for the debts incurred by, or on behalf of, the firm in the ordinary course of business.

Limited Partnership. The Limited Partnership Act, 1907, made legal in England a form of partnership long familiar in the south of Europe. A limited partnership consists of one or more *general partners* with unlimited liability, and one or more limited partners who are liable for the firm's debts to a stated amount only. A limited partner must not take any part in the management of the business, nor may he, during the continuance of the partnership, withdraw any part of his capital. In the case of a young man starting business, friends can assist in financing the business, their liability being limited to the amount subscribed. Firms already established sometimes avail themselves of this method of securing fresh capital, while retaining the original constitution of the firm.

Public Limited Companies. A joint-stock company is an association of individuals for the purpose of engaging in any undertaking, trade, or business, the shares of which are transferable. In this form a company differs from a

partnership only in the transferability of its shares. A public limited company incorporated under the Companies Acts has, however, other important differences. It is a distinct legal personality apart from its members, with power to own and deal with property: it can enter into contracts on its own behalf; and can sue or be sued in its own name. The liability of the members is limited to the amount of share capital subscribed by each: and the creditors of the company can look only to the property of the company, and not to that of the individual members, for the payment of its debts.

The development of the principle of company organization with limited liability has materially altered the organization and structure of industry. It gives an inducement to investment by limiting the risk; and enables investors to distribute their risks over a wide field; by concentrating the savings of many in the company form, it makes it possible to reap the advantages of large-scale organization and production to an extent which would have been otherwise impossible; while the permanence of the organization leads to a greater continuity of policy. It has led, further, to an almost complete severance between the ownership of capital and the control of the business in which it is invested. The shareholders elect the board of directors which is entrusted with the direction of general policy. The board in turn delegates most of its authority and executive power to a managing director, who controls the other salaried officials in whose hands rests the detailed operation of the company. In effect, therefore, owing to the large number of share-holdings, the individual shareholder has little control over the affairs of the company.

Private Limited Companies. A private limited company can be formed by any two or more persons provided it (*a*) restricts the right to transfer its shares, (*b*) limits the numbers of its members to fifty,[1] and (*c*) prohibits an invitation

[1] Exclusive of employees of the company, or of former employees who were members when employed and have continued members.

to the public to subscribe for its shares or debentures. This form of company has in effect made it possible for a partnership to secure the advantages of limited liability without the publicity of its affairs imposed on a public limited company. Many partnership firms have accordingly registered as private limited companies. In many cases, also, sole traders have adopted this form of organization, retaining the bulk of the shares in their own hands and thus becoming "one-man" companies.

Classifications of Capital

One of the essential agents of production is capital, which is generally defined as "the wealth of individuals and of communities other than land which is used to assist in the production of further wealth." John Stuart Mill considered[1] that capital consists of "whatever things are destined to supply productive labour with its various prerequisites." Under the conditions of modern production there is usually a long interval between the initial processes of production and the disposal of the finished product. Capital provides the means of subsistence for producers and workers during the period of production; it provides the raw materials and semi-finished articles necessary for the process of production; and at the same time it provides the machinery, plant, and appliances which so enormously increase man's productive powers.

The capital wealth of our country, then, apart from our foreign investments, consists of our stocks of food, raw materials, and finished goods; and of the factories, plant and equipment, machinery, transport systems, etc., used to aid production. But as capital exists in such a variety of forms, and is employed in so many different ways, it is necessary to note the various ways in which it is classified according to its productive functions.

1. **Individual and Social Capital.** This classification considers capital from the point of view of ownership. Private

[1] *Principles*, Book I, iv, 1.

property and possessions individually owned are called *private* or *individual* capital; while, on the other hand, that belonging to the community in general is called *public* or *social* capital. In any country the combined total of its social capital and the aggregate of the individual capital of its citizens forms the *national* capital.

2. **Production and Consumption Capital.** The term *production capital* is used to cover all material wealth such as plant, machinery, tools, and raw materials which are used in the process of production. *Consumption capital* includes all goods employed for the maintenance of the people during the progress of production.

3. **Sunk and Floating Capital.** When capital has been embodied in a form which renders it unsuited to any other purpose or which cannot be changed it is said to be *specialized* or *sunk*. On the other hand, when capital is in such a state that it can take any form or be used for employment at will in industry it is said to be *free*, *unspecialized*, or *floating*.

4. **Fixed and Circulating Capital.** Capital which is embodied in a durable form, such as factories and machinery, is regarded as *fixed*, since such things yield a return over an extended period and must be used a considerable time before they repay their original cost, and yield a profit on the capital invested. It fulfils its function in production not by a single use but by being used over and over again. It must not be supposed, however, that fixed capital is *permanent*. Whether it is used or left idle it wears out and deteriorates; it is liable to damage, accident, and breakdown; with advances in science and invention it becomes obsolete, and particularly during periods of rapid progress the rate of obsolescence may be very rapid. As the result of such factors provision must constantly be made for the depreciation and renewal of fixed capital. The stock of goods used as raw material in industry, as well as partly finished products which embody value paid out in the form of wages and salaries, fulfil their function by a single

use, by passing at once into the value of the finished product.

Since, however, this value is normally realized by sales within a short time, capital in this form is called *circulating*. This classification of capital into fixed and circulating is of considerable importance, since each is financing by a widely different method.

Capital and Enterprise

Without a system of banking and credit organization business undertakings would be formed only when the ownership of capital and the possession of business ability were concentrated in the same individual. There are, however, many people possessing capital who have no aptitude for business, just as there are many persons gifted with business and organizing ability who lack capital. With the development of agencies which bring these factors together the effectiveness of each is vastly increased while the productive capacity of the community is at the same time improved. The development of the modern type of business administrators is dependent on the machinery which places capital at their disposal. Every improvement in the efficiency of the machinery by which the command over capital is transferred from those who cannot or will not use it productively themselves to the hands of those who can, leads to a corresponding improvement in the efficiency of production.

Through the development of the money market it is no longer necessary in modern times that the individuals controlling the policy and management of a business should themselves provide the whole or the bulk of the capital employed in it. With the growth of joint-stock companies there has come a severance between the ownership of industrial capital and its management and administration. There is thus, in modern industry, a tendency for those charged with the administration and management of industry to be separated, both in person and in place, from

those who own the capital employed; though an opposite tendency is operating towards the re-union of the functions thus divided.

The Supply of Capital

In a simple and more primitive form of society the individual devoted his energies directly towards the satisfaction of his own needs. The products of his labours were his own property and intended for his own use. There was little exchanging to be done, and what little there was was affected directly so that there was no need for money. In the complex organization of modern society, however, the conditions are very different. The individual has become a specialist who confines his efforts to the supply of some specific service. The services of individuals are combined and co-ordinated to produce a stream of products the aggregate of which is the sum total of national production. The value of this, determined by the mechanism of exchange, is the National Dividend, which is distributed amongst all those whose services have assisted in bringing it into existence. Each individual receives as his income a share of the National Dividend, determined by the market value of the services rendered. This income, in the form of money, enables him to exercise a command over goods and services of a value equivalent to that of the services he has contributed.

The individual may exercise his command over resources towards the satisfaction of his present wants. That is to say, he can, by means of money payments, utilize his income so as to secure a supply of products which are destroyed by present consumption. In this case we would say that he "spends" his entire income. On the other hand, he may devote a portion of his income to providing for future wants. This may be done in either of two ways. He may employ it personally so as to direct industrial activities in the construction of factories, plant, machinery, or other forms of "capital" goods which

yield their utilities in the future. If he does not desire personally to exercise his command over resources, he may transfer this command to others in exchange for interest payments. In either case the action is effected through money payments which represent the amount he "saves."

It is important that the precise distinction between saving and spending should be clearly understood. Saving does not mean the withdrawal of purchasing power from circulation except in so far as it implies hoarding. It is, on the contrary, simply the direction of purchasing power into a different channel. If the amount saved be placed in a bank it will, as we shall see below, be lent to those who will effectively employ it; or if it be invested it will be used to meet expenditure. In either case it will soon be spent, so that saving is in effect indirect spending. The essential difference between saving and spending lies in the lines along which purchasing power is directed. Spending creates claims upon "consumption goods," or, in other words, upon the finished products of industry. Saving, on the other hand, generally results in the construction of "capital goods," and indirectly creates claims on consumption goods through wages and salaries paid in the process of their production.

The correct rates of saving and spending—or, in other words, the proportions of the national income devoted to the purchase of consumption goods and capital goods respectively—is an important factor in preserving the equilibrium of the economic world. "Over-saving" or "Over-investment" results in the provision of industrial equipment of excess capacity; while at the same time it reduces the amount available for direct spending so that it cannot carry off the additional goods produced. This over-production results in a period of stagnant trade and decreased production until the market has time to absorb the excess of goods produced.[1]

[1] See Chapter VII.

THE DEMAND FOR CAPITAL

Since capital exercises its functions through being consumed, whether rapidly or over a period of time, it must be renewed and replaced. There is therefore in the business world a constant demand for capital which includes the capital required for—

1. **The Foundation of New Enterprises.** Since funds provided for this purpose may be used by the entrepreneur in the provision of either fixed or circulating capital, this demand is included in the headings given below.

2. **The Provision of Material Equipment** which includes the factories, plant, machinery, and appliances necessary for modern production.

3. **Replacement of Fixed Capital.** Fixed capital when in use wears out or becomes obsolete. If left unused it deteriorates rapidly; and in all cases it is liable to damage or destruction by accident. A constant renewal of fixed capital is therefore essential, and provision for this must be made. "The flow of investment of resources for future needs consists of two streams. The smaller consists of new additions to the accumulated stock; the larger merely replaces that which is destroyed; whether by immediate consumption, as in the case of raw material, fuel, etc.; by wear and tear, as in that of railway irons; by the lapse of time, as in that of a thatched roof or a trade directory; or by all these combined. The annual flow of this second stream is probably not less than a quarter of the total stock of capital, even in a country in which the prevailing forms of capital are as durable as in England."[1]

4. **Provision of Materials** whether in the raw state or in the form of semi-manufactured or manufactured goods, which are used in the processes of production.

5. **The Provision of Subsistence.** Under modern conditions there is usually a long interval between the initiation of an industrial process and the sale of the finished product.

[1] Marshall, *Principles of Economics*, VI, vi, s. 6

During this interval provision must be made for the maintenance of all those who have contributed to the act of production. The same thing applies also in merchanting operations and in the export and import of goods.

6. Wastage of Capital. Partly through errors of miscalculation and partly through fraud large amounts of capital are wasted annually. Capital is sunk in mines which, having failed to yield minerals in a paying quantity, are abandoned: industrial undertakings are promoted which fail to market their goods at remunerative prices, and are eventually closed down. In such cases the capital invested, or at least the bulk of it, is irretrievably lost.[1] The total demand for capital includes, therefore, not only provision for the maintenance of existing material equipment and for net additions to that amount but also for this wastage in capital.

Demand is expressed by the "offer of things of value for things of value." In the case of capital the demand is expressed by the prospective net returns which it offers to the capitalist. "In the social interest capital should flow into business ventures in accordance with their prospective earning power; accordingly the social demand for capital is expressed simply by the prospective earning power of industrial ventures of all kinds. In this simple form it must be in a great measure ineffective; for the proper risks of the venture are increased in the view of the capitalist by his imperfect knowledge of the economic efficiency of the venture and by the possibility of fraud on the part of the borrower. The 'economic distance' caused by these additional risks is small when lender and borrower are in close touch, but widens as the two parties have less knowledge of one another and is at its maximum when a new undertaking is endeavouring to obtain capital in the public market."[2]

The Gap between Supply and Demand. On the one side, then, we have those who have a command over capital, and on the other we have those who bid for its use; while the two groups are separated by a gap created mainly by imperfect knowledge on the part of the investors. The investor aims at placing his capital where it will yield him the highest net return. To do this properly he requires a full knowledge not only of those who are competing for the use of capital, but also of the nature and risks of the enterprises for which the capital is required. This knowledge is not within the reach of the ordinary investor, and the lack of it creates a gap between supply and demand. In cases where the demand and supply are "local," where those seeking capital have a high business reputation, or where there is ample security to cover the investment, the gap may be easily bridged; but this cannot apply in the case of the flotation of new undertakings owing to the capitalist's imperfect knowledge of the risks. In some cases this imperfect knowledge will discount the true risks, thus causing capital to flow into enterprises with little reasonable prospects of success or into the pockets of fraudulent company promoters; in other cases by magnifying the risks it may prevent the flow of capital into useful undertakings. There is thus a gap between the supply of capital and the demand, which must be bridged if the demand is to become effective in production. The bridging of this gap is effected through the operations of the money market, one of whose two main functions is to facilitate the transport of capital; the other function being the provision of the money medium necessary for effecting exchange.

The Money Market

In a sense, of course, every market where commodities are exchanged is a "money" market, since money forms one side of the exchange. The term "market," furthermore, implies purchase and sale, but in the money market money is not bought and sold; it is borrowed and lent. Instead of

a "sale price," therefore, we have a "hiring charge," which explains the use of the terms "cheap" and "dear" as applied to money. The principal lenders are the banks; the principal borrowers consist of bill brokers and discount houses which utilize the borrowed funds by discounting bills, and stock-exchange brokers who employ the money in facilitating deals in securities.

SPECIALIZED INSTITUTIONS

The English capital market is an organization of much wider scope than the money market. The Bank of England is the centre of the English money market; then come the joint-stock banks; the merchant banks or accepting houses; the issuing houses, the discount houses, and bill-broking firms; the stock exchange; the insurance companies; the bullion firms; the savings banks; the investment trust companies; and the Clearing House. Specialized institutions such as these form the money market proper. "The capital market not only includes the specialized organizations of the money market, but it extends beyond this centre forming an outer market which includes the work of the solicitor who arranges for the transfer of capital on mortgage, of the provincial broker who promotes the sale of new and old securities, of building societies which facilitate investment in houses, of the system of trade credit and of those less definite arrangements for facilitating the movement of capital which, as the market is extended outwards, become more and more closely bound up with the ordinary processes of trade and industry."[1] In order that the methods of financing industry may be fully grasped it is necessary that the work of certain of these specialized units of the money market be examined in greater detail.

The Banks. We are not concerned here with the work of the banks in providing the necessary medium of exchange, but rather with their work in effecting the transfer of

[1] Lavington, *The English Capital Market*, p. 6.

capital. From this point of view banks are institutions which accept money from the public for safe custody. The bank undertakes to repay the money left on current account, on demand; or on proper notice if placed on deposit. Only a small proportion of the money in the custody of the banks is required by them for cash payments, since the system of payment by cheque results in the cancellation of indebtedness between individuals or firms without the need of currency. The banks, therefore, have always a considerable surplus available for investment. Since, however, they are liable to the depositors for this money, and since there is a possibility, even though it is a remote one, that they may be called on for immediate repayment, banks use their surplus funds mainly for short-term investments which afford ample security. The banks therefore, are the chief agencies for the supply of short-term capital, and by assuming the responsibility for investment they relieve the capitalist of the entire burden of management of their disposable funds.

The Discount Houses. The business of bill-broking is carried on by a number of joint-stock companies[1] as well as by private firms. Bill-broking means simply trading in bills of exchange—discounting, buying, selling, or holding them until maturity. The bills are bought from merchants and many of them are sold again to the banks. The bulk of the first-class trade bills pass through the hands of these dealers, though it may be observed that the proportion dealt with by the banks has considerably increased in the post-war period. Many of these firms also deal largely in Treasury Bills, accept money on deposit, and lend money against securities. The business of bill-broking requires a thorough knowledge of the condition and tendencies of the market; and in addition it demands a wide knowledge of the financial standing and business reputation of business firms. It is also a business requiring a command over large

[1] Such as Alexander's Discount Co., Ltd., The National Discount Co., and The Union Discount Co., Ltd.

amounts of ready cash, so that bill-brokers borrow largely from the banks by loans repayable "at call" or for short periods.

The Accepting Houses or Merchant Bankers. These firms do not carry on banking in the sense that cheques are drawn on them by customers. They are firms[1] of high standing and wide reputation who undertake to accept by arrangement bills of exchange, on behalf of the traders on whom they are drawn. Thus, for a commission, they exchange their "wide credit" for the narrower credit of traders not well known, and by their endorsement convert their bills into "first-class" trade bills. The accepting houses render valuable services in facilitating the financing of international trade.

The Investment Trust Companies and Finance Companies. These form a large group of joint-stock companies, managed by experts, and the activities of which cover a very wide field. Essentially they are expert investment agencies. The capital employed is obtained from the public who buy the company's shares in the open market. These companies also borrow largely from the banks in the form of temporary advances. The money obtained in these ways is reinvested in a large number of securities or undertakings. It may be used by way of loan or by direct investment in shares; new business enterprises may be promoted or existing concerns converted into joint-stock companies; existing undertakings may be acquired and administered; the business of discounting bills or underwriting new issues may be carried on; or the capital may be employed in many other ways. "Regarded broadly, the nature of the work done by these companies seems to be midway between that of the banks and that of the market for new negotiable securities. They resemble the banks in their operation, inasmuch as they take over from the public the work of management of the capital entrusted to them, administer it as principals, and depend for their profits on their success

[1] Such as Barings, Rothschilds, and Brown, Shipley & Co.

in carrying it to the points of highest return. But their work is more nearly akin to that of the securities market in that it is concerned with the supply of capital for long periods of time. As a broad generalization it may perhaps be said that their typical service lies in supplying capital for the more speculative kinds of industrial enterprises mainly in foreign countries."[1]

The Work of the Capital Market

Through the operation of the specialized institutions enumerated above and through other agencies the market collects capital from the public, usually in a very large number of small amounts; it finds those who make an effective demand for capital; carries the capital to them; and recovers it after the period of use has expired. In connection with the last-mentioned services it is necessary to notice the important part played by the stock exchange.

Capital is supplied: (*a*) By way of *loan* as when a banker grants an overdraft to a customer or an individual subscribes to an issue of debenture; (*b*) By way of *purchase* as when a member of the public takes up the shares of a new company. In the former case the lender is the creditor of the borrower and is entitled to recover the use of the capital when the money is repaid. In the latter case the investor has no such right of recovery as he becomes a shareholder or part proprietor of the company. Further, though his share holdings give him a voting power at shareholders' meeting, yet in effect he has practically no control over the disposal of the capital subscribed. The fact that those supplying capital in such cases not only relinquish the power of control over it, but also lose the right to recover it would materially reduce the supply of capital forthcoming. The stock exchange, however, by affording an open market in which the capitalist can sell his shares at will, gives him the power of recovering the capital supplies.

[1] Lavington, *The English Capital Market*, pp. 120–121.

While the specialized institutions of the inner capital market are thus peculiarly effective in bridging the gap which exists between the supply of and demand for capital, it must be remembered that the outer market also plays an important part in this work. "Since the boundaries of the money market in its widest sense are themselves indefinite, the scope of its work cannot be defined in figures. But if account is taken only of the specialized organizations forming the money market proper, it seems reasonable to conclude that the resources which are annually applied, through their agency, for the expansion of the business capital of the country probably do not amount to one-half of the total annual stream of new home investment. It seems still to be true that the predominant methods, by which business men in this country are supplied with the resources they require to extend their operations, are those where the economic distance to be bridged is small, where capital has not far to go, where the sources of demand and supply are connected by personal or business ties, or in the limit are identical. It is supplied mainly, it may be presumed, by way of partnership, in that broad sense of the term in which it includes private joint-stock companies; by way of borrowing from personal and business friends; and, above all, in the form of persistent re-investment of profits by which small businesses are continually growing into large undertakings in almost all branches of industry and trade."[1]

Financing of New Industrial Undertakings

The amount of capital required for the establishment of a new industrial enterprise varies enormously with the nature and scope of the undertaking. Provision must be made for the purchase, lease, or erection of new premises, and if premises are bought or leased, for the cost of the necessary adaptation; the purchase and installation of plant, machinery, and equipment; the supply of raw

[1] Lavington, *The English Capital Market*, p. 281.

materials or partly-finished products required in the process of manufacture, and for the replacement of this supply as used until payment for sales begins to come in; for wages, salaries, freight, advertising, and similar charges coming under the heading of working expenses; and, if the undertaking is organized in the "company" form, preliminary and other formation expenses. While new enterprises usually make adequate provision for the amount of fixed capital required, due allowance is not always made for a sufficient amount of circulating and working capital. A shortage in this respect is a severe handicap to a new undertaking, as it weakens and cramps its industrial activities and retards the possibilities of development. The initial capital, therefore, of a new enterprise should be sufficient to put the business in full working order; to carry it on over the interval between initial production and payment for goods sold; to provide ample working capital; and to provide a margin for possible expansion in the immediate future.

If the new enterprise is owned by a sole trader, a partnership, or a private limited company, the necessary capital must be provided from the proprietor's own resources, or part may be borrowed on mortgage with the fixed assets as security.

New concerns of small size, known only near home, will usually be dependent upon local capital. Though in this country the financing of new undertakings is not considered a suitable investment for banks to undertake, it is nevertheless true that a man of proved ability and high business reputation will often be enabled to start in business for himself in a small way by the assistance of a bank. The promoters of large enterprises cannot usually obtain the necessary initial capital locally, and must endeavour to attract it from a much wider field—the general public.

Large enterprises are usually organized as public limited companies, and the capital is subscribed, often in comparatively small amounts, by investors spread over the country. The individuals responsible for the establishment

of a new enterprise have usually neither the knowledge nor experience necessary for the flotation of a new company. They consequently seek expert assistance from one of the firms engaged in that part of the work of the capital market which deals with new securities. Such firms include the issue houses, the company promoters, financial houses, underwriters, etc. Sometimes these firms will provide the necessary capital themselves, but usually they simply promise to provide it in case they fail to induce the investing public to do so. They undertake to provide the necessary capital by inviting the public to subscribe for shares, and guarantee to pay the total amount whether the whole of the shares issued are taken by the public or not. The underwriting firms undertake the marketing work in bringing the shares before the public and also bear the risk of the public failing to supply the capital required. For these services they are remunerated by a commission which varies according to the prospects of success of the issue. In the event of only part of the issue being taken up by investors, the underwriters take over the balance and offer it later on the stock exchange at a discount, the loss being borne by the underwriters.

Provision of Fixed Capital

A successful enterprise which has been in operation for some time, desiring to provide new premises, plant, or machinery, may be able to utilize accumulated reserves for the purpose. It is not every enterprise, however, which is in this fortunate position, and the majority of firms will have to raise the necessary capital otherwise. In the case of a private firm this may usually be done by arranging for a mortgage on the fixed assets as security. If this cannot be managed, it will usually be necessary to obtain the required amount by way of private loan. The provision of fixed capital is essentially a "long-term" investment and is subject to all the risks associated with investments of this nature. The banks are the largest lenders on the market,

but their loans are usually for short periods; and a bank will not, in general, risk tying up its funds in fixed capital. On the other hand, such an investment is attractive to the ordinary investor who is prepared to take a slight speculative risk. It is very much easier for a limited company to obtain additional capital than it is for a private firm. The ordinary investor will usually subscribe readily to a public company's issue of preference shares or debentures, which are secured as a prior charge on its assets or earnings. Such securities have an open market on the stock exchange, and the investor feels secure in that he can realize on them at short notice.

Where a public company, requiring additional capital, does not wish to increase its issued capital, or where its need is of a temporary nature only, the amount required is usually obtained by an issue of debentures. The method pursued is similar to that described in the issue of the shares of a new company. Instead of shares, however, which make their owner a part proprietor of the company, bonds are issued.

Debentures. These may be either a mere promise to pay, in which case they are called "simple" or "naked" debentures, or they may be secured by a mortgage on the real estate and a first charge on all the assets and undertakings of the company, and are then called "mortgage" debentures. In the event of liquidation of the company the holders of "simple" debentures rank as ordinary trade creditors. "Redeemable" debentures provide for the repayment of the principal at a given date or upon notice; whereas, if the debentures are "irredeemable," the principal becomes repayable only on default in the payments of interest, or on the winding-up of the company. A debenture holder has, therefore, greater security for his capital than a shareholder, since the latter is entitled to the payment of a dividend out of *profits* while the debenture holder is entitled to the payment of interest, so long as there are any *assets* out of which to pay it.

Provision of Circulating Capital

Production usually takes place in anticipation of demand. In modern industry, the period between the initiation of the industrial process and the receipt of payment from the sale of the finished product is usually lengthy. During this period, capital is required for the purchase of stocks of raw materials or semi-finished goods; for wages, salaries, freight, advertising, and overhead charges. As we have seen, such capital is called "circulating," and though the funds it represents are normally realized sooner or later in the value added to the products, it is impossible to call them in as long as the business continues in operation.

The amount of circulating capital required by a business firm depends on a variety of factors, such as the nature of the undertaking, the customary terms of credit, and the nature of the markets for raw materials and finished products. The longer the terms of credit given to the firm for its purchases of raw materials, etc., and the shorter the credit terms afforded by the firm, the smaller will be the amount of working capital required. The certainty or irregularity of the market for raw materials will determine whether large or small stocks must be carried; while the production of products subject to a continuous demand involves a smaller proportion of operating capital than if the demand is seasonal.

While fixed capital assets can be pledged as security for money borrowed, the same does not apply in the case of circulating capital. It is usually true that "goods in progress" represent an asset of considerable value. But if the process of production is to continue, it is essential that the manufacturer should personally retain the power of disposal in respect to these goods. The fact that the price realized for the products may prove insufficient to recover the amounts expended, makes the realizable value of circulating capital uncertain; but in any case, since it is not embodied in tangible assets, it is not acceptable as security for credit advances. Well-established firms which have

been carried on successfully for a number of years may hold securities which the banks will accept against credit facilities for the amount of circulating capital required. Otherwise, however, provision for circulating or working capital must be made from the resources of the proprietors or shareholders; and it is necessary that such provision should be ample if the progress and development of the business is to be unhampered.

Financing of Commodities

The tendency towards geographical specialization, which was a marked feature of the industrial development of the nineteenth century, has resulted in the centralization of modern industry in highly-organized industrial areas. In these centres are concentrated stocks of raw materials drawn from widely separated producing areas. From these centralized areas, vast supplies of goods produced under large-scale conditions flow outwards to meet the demands of the local market, the national market, and the world market; and to satisfy the needs of millions of consumers all over the world. Under modern conditions, production takes place in anticipation of demand, and the time interval between production and consumption is often considerable; while, furthermore, the goods are produced in large quantities, but are bought by the consumer in small quantities or in single units. It is inevitable, therefore, under these conditions, that, at any moment, vast aggregate quantities of goods are held by manufacturers, wholesale and retail merchants. The capital value represented by these stocks is enormous, and normally it would be beyond the resources of individual manufacturing or merchant firms to provide the capital necessary to finance the stock of goods carried; and even if the necessary capital were available, it could be much more profitably employed. The financing of these stocks of commodities is effected mainly through the operation of two expedients, viz.: trade credit and bills of exchange.

Trade Credit. The existence of the large class of small merchants and traders is dependent, to a considerable extent, on the merchants who supply them on credit with the bulk of the stock they hold. This credit must, in most cases, be supplied without security; or, in any case, without security of a nature which would be acceptable to banks or other large lenders. Those who grant trade credit must have a special knowledge of the business character and means of the parties to whom it is granted; and their personal information, supplemented by the work of commercial inquiry agents, such as Stubbs' or Perry's, promotes an increased mobility of capital, since by it "business reputation is made effective as a power to borrow." "The main characteristics of trade credit as a means of supplying capital, appears then to be these: by its means a class of borrowers who can offer little or no security except their character and business record are enabled to obtain supplies of capital for short periods from lenders who have special knowledge of their trustworthiness and business circumstances: It is the means, therefore, by which many retailers are enabled to set up and maintain independent businesses and by which business men in general are often enabled to tide over temporary emergencies." [1]

Bills of Exchange. By the system of trade credit, facilities are provided for the financing of commodities, but the individuals affording the credit have to provide the necessary capital for this purpose. By a further expedient, in the use of bills of exchange, the expense of financing commodities is largely taken over by persons other than those who actually conduct the trading operations. The seller of goods "draws" a bill of exchange upon the buyer who, by "accepting" it, undertakes to make payment at some future date to the person in possession of the bill. The buyer thus receives credit for the terms of the bill, since payment is not due until that period has elapsed. On the other hand, the seller of the goods can take the bill to a

[1] Lavington, *The English Capital Market*, p. 115.

bank, which will "discount" it, or, in other words, pay him the sum named less interest at the current rate for the period which the bill has still to run. Through the agency of the bank which thus finances the transaction, the producer is enabled to receive payment for his goods, before the merchant who buys them is ready to pay him. The bill of exchange is thus a powerful instrument for effecting the transfer of capital; and its successful operation in this respect depends on the diffusion of information as to the reputation and solvency of the parties to the bill. Since the banks are in intimate contact with the business men of the country, they are in an exceptional position to judge of the soundness of the security. Signed by substantial business firms, or backed by the guarantee of one of the "accepting houses," these bills offer a sound security; while their currency is usually short, averaging less than three months. Thus, from the point of view of British banking policy, the discounting of first-class trade bills offers an ideal method of utilizing the surplus funds of the banks, since these bills offer a short-term investment with sound security.

FINANCING OF CONSIGNMENTS

Under modern conditions of international trade, enormous quantities of goods, both in a raw and in a manufactured state, are constantly in transit from one country to another. Between the dispatch of a consignment of, say, raw cotton or timber and its receipt by the importer an interval of weeks or even months will elapse. The producer, having used the bulk of his resources to bring his products to a state of readiness, will sell only against prompt payment. On the other hand, the importers cannot afford to pay out of hand, and then wait until the material is shipped, transported, worked up, and sold before they are put in funds again.

The part played by the bill of exchange in the financing of commodities in the home trade has been noted above.

In international trade it is of much greater relative importance, since the bill of exchange is the main instrument employed in the settlement of international obligations. Here again, since neither the exporter nor the importer can bear the strain of financing consignments during the period of shipment, the burden is borne by the banks, since they are, in fact, the only organizations capable of doing so. The foreign bill of exchange is an even better type of investment from a banking point of view than the inland bill, since the former affords not only a personal security but a tangible security as well. Though there are unsecured credits created by the banks, in general the bank will grant the accommodation required to finance a shipment, not as an open loan, but in such a way that the legal ownership of the goods throughout the period of transit is vested in the bank which can retain it until the customer is able to repay the sums advanced on his behalf.

Let us suppose that a London importer has bought goods from a foreign producer and that the shipment is being financed through a London bank. The London bank instructs its branch or agent bank in the foreign country to honour the drafts of the producer in accordance with the authority extended. The producer, having shipped his goods and effected a policy of insurance on the shipment, draws a bill payable at so many days after sight on the importer for the value of the goods. In exchange for the bill of lading and the policy of insurance, the agent bank will discount the bill, so that the producer thus receives cash for his goods. The bill, with the documents of title attached, is forwarded by mail to the London bank. These documents are retained by the bank until the importer has "accepted" the bill, when they are handed over to him, thus enabling him to obtain possession of the shipment. Should the importer fail to accept the bill the bank can reimburse itself by the sale of the shipment; in the event of loss by fire or accident during transit, the damage is covered by insurance.

Banking and Industry

The policy of British banking in regard to the financing of industry is in marked contrast to that of the Continental and American banks. This divergence in practice is to a considerable extent due to the fact that different historical conditions have led to development along different lines; and this in itself is also responsible for the growth of Continental banks specializing in the financing of industry. In order that the difference in policy may be made clear, it is necessary to contrast the different methods employed in the chief industrial countries.

England. In England, commerce developed before industry, and for a great part of her history England has been a great commercial and trading nation. This commerce centred in London, which was the great entrepôt for trade between the Continent and the rest of the world. London's financial organization naturally adapted itself to the needs of its commerce, and among other developments we may note the rise of the great private merchant banking houses. With the growth of British industry in the nineteenth century, developments took place largely on individualistic lines. The individual industrial undertaking was comparatively small, and was on a family basis. Capital was provided privately or from profits; short term advances were obtained, when necessary, from local banks; so that in general, industry did not depend on the London money market for its financial requirements. With the development of joint-stock enterprise, a supply of capital became available from the large class of private individuals, who relied mainly on their own judgment, in the choice of investments. The growth of public limited companies led to the development of specialized intermediaries like financial houses to facilitate the provision of the initial capital for new undertakings, while the banks continued to supply short-term credit. British industry, therefore, while it utilized to the full the banking facilities afforded by the

banking system, was enabled to retain its independence free from financial control.

Germany. Industry developed later on the Continent than in Great Britain. Manufactures had been carried on mainly as small handicraft industries, so that the manufacturers were unable to supply the requisite capital for the establishment of industry on a modern basis. On the other hand, private investors were unwilling to risk investment in the new industrial undertakings, but preferred government or foreign securities. The banking system at that time consisted of (*a*) great private banks such as Rothschild's, which were mainly concerned with government finance, (*b*) small private banks which were in effect money changers, though they sometimes dealt in public securities, and (*c*) deposit banks which from the nature of their business were not suited to incurring industrial risks. A new form of financial institution, to assist industry to obtain permanent as well as short-period capital, was required, and this need led to the establishment of credit banks, with as one of their main objects the promotion of industrial firms. While these banks deal with industry in general, special banks have also been formed to finance the promotion and development of particular industries.[1]

In Germany, "the relationship between a bank and an industrial or trading company commences with the latter's formation. Scarcely a single important company in Germany has been founded without the collaboration of a bank. Whether it is a case of converting a private firm into a limited company, or of exploiting a new invention by establishing a new enterprise, the assistance of a bank is always invoked. . . . If the bank, after examination, decides to found the company, it draws up the scheme of financing, determines the amount and the type of capital to be issued, and then in some cases, itself takes a part of the shares into its security portfolio, with the idea of issuing

[1] E.g the mining, electrical, and brewing industries.

them at a later date. In this way the founding bank becomes at the same time, the issuing bank, the latter function beginning, however, only with the introduction of the shares to the stock exchange through the intermediary of the bank." [1]

As a result of the part played in the promotion of industrial companies and of their share holdings, credit banks can place their representatives on the boards, and can exercise an important influence on their policy and control. The system of interlocking directorates by which bankers hold seats on the company boards while industrial leaders hold seats on the bank boards emphasizes the close connection that exists between German banking and industry. Through the intimate knowledge of the position of industrial firms thus acquired, German banks are better placed than British banks to form a judgment on the soundness of industrial requests for financial accommodation. On the other hand, the result of the long-term loans made, or of the industrial shares held, serves to lock up a considerable proportion of the bank's capital, which may be disastrous in times of severe industrial depression.

France. In France the *banque de dépôt* exercises functions very similar to those performed by British banks. The *banques d'affaires*, on the other hand, are powerful and influential concerns which undertake work similar to that of the German credit banks, and are closely interested in the development of industry at home and abroad. The amount of investment capital available in France is greater than in Germany, but the amount held by each individual investor is on the average small. Furthermore, the investor is guided by the advice of the banks which not only make industrial issues but, to some extent, assume responsibility for their soundness. In some cases of new issues, the bank may subscribe the entire capital, paying the legal requirement of 25 per cent of the amount subscribed, and carry

[1] Dr. J. Goldschmidt. Evidence (ss. 5–6) given before the Committee on Finance and Industry.

out the formation of the company before offering the shares to the public.

The United States. The American banks, though by a different system, render to American industry substantially the same services as are rendered to industry in Germany by the banks there. In the United States, the banks, both public and private, pledge their credit for the soundness of the issues they sponsor. There, as in Germany, the banks play a leading part in all industrial issues and, in particular, in the formation of the great American corporations or trusts. In the case of the larger issues, a number of financial institutions will combine; in some cases, the issues are not made directly, but through subsidiary securities companies; but in all cases it is made clear to the public as to the institutions which are responsible for the issue. It is therefore necessary, for the sake of their own credit and reputation, that the responsible banks should continue to take an active interest in the affairs of the new company; and this interest is extended to the market values of industrial securities generally by the fact that a considerable proportion of their advances to customers are made against such securities.

Conclusions

Opinion is divided as to the respective merits of the British and Continental policies as an aid to industrial progress. The English banking practice of non-interference with the management of industrial enterprises has undoubtedly worked well in the past. The increasing complexity of modern industry has resulted in the development in each branch of industry of conditions and problems peculiar to itself. Each particular industry, therefore, requires men of specialized knowledge and experience in order to secure effective management and administration. The skill and experience of the specialized industrial leader whose life has been spent in acquiring a knowledge of the problems of a particular trade cannot be subordinated to

the opinions of a financial expert who lacks that knowledge, without injury to the industry.

From the very nature of the business in which they are engaged, a banker's personal qualities and general training differ essentially from those of an industrial leader. Extreme caution, avoidance of risk, the provision of an ample margin of safety, and the possession of security which are a guarantee against loss, are characteristic of the banker's everyday transactions; while, on the other hand, enterprise, initiative, foresight, and a readiness to take risks are typical of the successful business man. When, in addition, the many and varied functions of modern banking are considered and the specialized knowledge and technique required for their performance, it seems undesirable that the banker should add to those functions that of exercising a controlling influence over industrial enterprises. Against this, however, may be pointed out that the financial expert is in many respects better qualified than the specialized industrialist for taking a wide and detached view of the industrial situation. While he is admittedly less qualified to deal with the organization and control of the actual operations of industry, "he is in a position such as no man has yet been for grappling intelligently with its primary problem . . . the problem of the right direction of the flow of productive resources into the several channels demanding their use."[1] In recent years there has been ample evidence of the steadily increasing power exercised by financiers over industry. The social dangers of such a system are obvious. The combination of "monopolistic control" of industry with great financial resources gives a financial group such a formidable power that, even though it be not employed unscrupulously, it is certain to be used for its personal enrichment at the expense of the consumer.

It is contrary to British ideals that the banks should in any way manage industry. "A banker must never forget that he cannot and must not be an industrialist.

[1] Robertson, *The Control of Industry*, p. 83.

He can only play his real part in assisting a company by concentrating on the tasks and possibilities which present themselves from time to time in the case of every industrial enterprise. It is and must be the rule that the industrialists themselves should be responsible for the business and general management of a company, and that the banker should be the adviser on matters of finance." [1]

On the whole, it seems to be clear that the interests of British industry are best served by the policy pursued by British banks. It is, however, equally clear that a closer connection between the money market and British industry would not only benefit both industry and the financial community but that it would be advantageous to the investor. "If those at the head of our financial world have a close knowledge of industry they will be far more able to assist in meeting the problems of the future than if finance and industry are in water-tight compartments." [2]

In the provision of circulating capital for British industry the financial machinery of the money market has been so organized that through the system of short-term credits capital flows easily to those points at which there is an effective demand. In the provision of capital for long-term investment, however, the case is different. Though it is a matter of vital importance to the community that its savings should be invested in those enterprises at home which are likely to be most productive, yet in some respects the money market is more highly organized to provide capital to foreign countries than to British industries. The soundness of foreign issues is vouched for by the high standing and reputation of the issuing houses which sponsor them; in the case of home industrial issues there is no such security, and this failure to afford guidance to the investor as to the true prospects or the security afforded by capital issues is a definite weakness in our financial organization.

[1] Dr. J. Goldschmidt. Evidence (s. 14) given before the Committee on Finance and Industry.

[2] The Committee on Finance and Industry Report, p. 168.

"It would in our opinion be an important reform that relations between finance and industry should be so developed that issuing institutions of first-class strength and repute should vouch to the investor more normally and more fully for the intrinsic soundness of the issues made, and that the joint-stock banks should not give the appearance of sponsoring issues so long as in fact their real responsibility is limited to receiving subscriptions. In this way, the investor would be encouraged to support well-vouched issues and be put on his guard against others." [1]

[1] The Committee on Finance and Industry, Report, p. 168.

CHAPTER VI

COMBINATIONS IN INDUSTRY

Increasing Size of Industrial Unit

PERHAPS the most marked characteristic of modern industry and commerce is the constantly increasing size of the average business unit This change has operated in two ways—an increase in size of the individual business unit and an amalgamation of several units into one. Alongside of this the form of organization has also changed, as the company form has largely replaced the individual owner and the ordinary partnership. A return issued in U.S.A. before the war period indicates the extent to which great industries and large-scale production dominated their manufacturing industries. Establishments whose annual output exceeded $1,000,000 constituted 1·4 per cent of the total number of establishments; but manufactured 41·4 per cent of all the goods.

By 1929, the last year in which establishments were classified according to size, the proportion of such establishments had increased to 5·6 per cent of the total, manufacturing 69·2 per cent of the total value of the products.

Details of the rate of increase are shown in the table on page 139.

From the closing years of the nineteenth century the increase in the number of amalgamations has attracted public attention and aroused public anxiety. Manufacturing syndicates tend to obtain control of an entire branch of industry in a country and even in the world. Even governments have become alarmed at the monopolistic power developed by such bodies and have attempted, ineffectively, to curb them.

Industrial Establishments in U.S.A.

MANUFACTURES: Establishments, Classified by Value of Products[1]

Data by size of establishments were not compiled for 1927 and 1931

Class of Establishments according to Value of Products	Establishments		Wage Earners		Value of Products	
	Number	Per cent Distribution	Average Number	Per cent Distribution	Amount	Per cent Distribution
Less than $5000:						
1929	(2)	—	(2)	—	(2)	—
1925	(2)	—	(2)	—	(2)	—
1923	(2)	—	(2)	—	(2)	—
1921	[3]53,999	—	[3]40,924	0·6	[3]$136,926,075	0·3
1919	60,215	—	41,252	·5	151,631,298	·2
1914	95,408	—	127,495	1·8	228,653,956	·9
$5000 and over:						
1929	210,959	100·0	8,838,743	100·0	70,434,863,443	100·0
1925	187,390	100·0	8,384,261	100·0	62,713,713,730	100·0
1923	196,309	100·0	8,778,156	100·0	60,555,998,200	100·0
1921	196,267	100·0	6,946,570	99·4	43,653,282,833	99·7
1919	214,383	100·0	9,000,059	99·5	62,041,795,316	99·8
1914	177,110	100·0	6,896,190	98·2	23,987,860,617	99·1
$5000 to $20,000.						
1929	69,423	32·9	202,958	2·3	771,417,436	1·1
1925	55,876	29·8	156,373	1·9	628,373,403	1·0
1923	61,981	31·6	189,738	2·2	697,996,736	1·1
1921	71,075	36·2	224,852	3·2	782,977,433	1·8
1919	79,699	37·2	227,977	2·5	866,086,290	1·4
1914	86,587	48·9	423,829	6·0	893,459,166	3·7
$20,000 to $100,000						
1929	75,225	35·7	693,155	7·8	3,587,697,276	5·1
1925	68,951	36·8	660,309	7·9	3,272,196,872	5·2
1923	72,370	36·9	718,746	8·2	3,426,433,520	5·7
1921	72,251	36·8	746,024	10·7	3,330,350,409	7·6
1919	75,627	35·3	773,701	8·6	3,487,756,280	5·6
1914	56,557	31·9	995,743	14·2	2,540,949,405	10·5
$100,000 to $500,000:						
1929	44,153	20·9	1,672,983	18·9	10,023,771,653	14·2
1925	42,209	22·5	1,675,911	20·0	9,576,090,022	15·3
1923	42,075	21·4	1,721,266	19·6	9,496,592,898	15·7
1921	38,027	19·4	1,629,573	23·3	8,405,758,540	19·2
1919	39,447	18·4	1,712,854	18·9	8,929,364,110	14·4
1914[4]	30,147	17·0	3,000,612	42·7	8,759,391,117	36·2
$500,000 to $1,000,000						
1929	10,395	4·9	1,121,547	12·7	7,294,860,945	10·4
1925	9,771	5·2	1,131,439	13·5	6,870,112,293	11·0
1923	9,556	4·9	1,134,897	12·9	6,752,818,172	11·1
1921	7,581	3·9	966,559	13·8	5,296,720,583	12·1
1919	9,197	4·2	1,112,815	12·3	6,457,485,019	10·4
1914	(5)	—	(5)	—	(5)	—
$1,000,000 and over.						
1929	11,763	5·6	5,148,100	58·3	48,757,116,133	69·2
1925	10,583	5·7	4,760,229	56·7	42,366,941,140	67·5
1923	10,327	5·2	5,013,509	57·1	40,182,156,874	66·4
1921	7,333	3·7	3,379,562	48·4	25,837,475,868	59·0
1919	10,413	4·9	5,172,712	57·2	42,301,103,617	68·0
1914	3,819	2·2	2,476,006	35·3	11,794,060,929	48·7

[1] To make the percentages for the number of establishments comparable, those for all six years have been based on the number of establishments reporting products valued at $5000 or more. The percentages for wage-earners and value of products, however, have not been similarly adjusted, the comparability of these percentages having been affected very slightly by the omission of small establishments in 1923, 1925, and 1929.

[2] No data for establishments with products under $5000 in value have been tabulated for 1923, 1925, and 1929.

[3] The data for the 53,999 establishments in the "Less than $5000" class are not included in other tables showing statistics for 1921.

[4] Figures include data for the $500,000 to $1,000,000 class.

[5] Data included with the $100,000 to $500,000 class.

Source: Bureau of the Census, Department of Commerce.

Classifications of Monopoly

While there is some difference of opinion among economists as to the exact meaning which should be given to the term "monopoly," it is usually taken to mean an effective control over either the supply of, or the demand for, particular goods or services. Monopolies may exist for a brief period only, as in the case of a "corner" in the wheat market, or they may last over an extended period. Monopolies of demand are comparatively rare, since they imply an association of the great majority of the consumers of a commodity.[1] In general, therefore, the term "monopoly" is taken as meaning a monopoly of supply, which implies that the monopolists exercise an effective control over the bulk of the supply of some commodity or service.

Monopolies have been classified in many different ways,[2] and in some of these there is considerable overlapping. The following classification has the advantage of clearness and simplicity—

1. **Natural or Geographical Monopolies** arise when the supply of a raw material or other form of natural wealth is confined to a particular area or country. Thus, Britain has a monopoly of first-grade anthracite; the supply of nitrates is monopolized by Chile; while South Africa controls the world's supply of diamonds.

2. **Artificial Monopolies** are those where the power of control over goods or services is exercised as a result of the

[1] A monopolist of supply may exercise a monopoly of demand over the raw materials used in the process of manufacture This is exemplified in the case of Unilever, Ltd , who have a practical monopoly of demand for the vegetable oils and animal fats used in the production of soaps and margarine

[2] Professor Taussig divides monopolies into—

1. Absolute, which may arise either
   (a) As a result of legal protection as in the case of patents, or
   (b) From the control of natural resources.
2. Industrial, which may be sub-divided into
   (a) Public service industries,
   (b) Trusts.

— *Principles of Economics*, Vol. II, pp. 113–118.

action of the State or through a combination of the interests concerned. These may be further divided into—

(*a*) *Legal Monopolies* where the right of control is conferred or protected by law. These are intended to promote the production or regulate the consumption of commodities in furtherance of the public welfare. Patents, copyrights, and trade marks are examples of the former; while licences granted to public houses or hotels illustrate the latter.

(*b*) *Social Monopolies* are those undertaken or controlled by the Central or Local Government in the supply of services where monopoly is more conducive to the public welfare than competitive enterprise. This is evident in the case of the Post Office, which is a State monopoly; or in the gas, water, or electric-light undertakings of local authorities, where monopoly results in greater economy and convenience The same principle underlies the monopolistic rights granted by the State to canals and railways.

(*c*) *Voluntary Monopolies* are those that result from the associations or combinations of producers formed for the purpose of controlling supply or the elimination of competition. It is this class of monopoly which is most typical in modern industry.

Professor Ely, the American economist, uses a different principle of classification[1] when he groups monopolies according to the *degree* of control exercised. According to this division—

(*a*) **An Absolute Monopoly** exists when control is exercised over the *entire* supply of a commodity or service, e.g. the gas company which provides the entire light of a town.

(*b*) **A Complete Monopoly** exists when a combination, by controlling over 75 per cent but less than 100 per cent of the supply of an article, is able to fix prices.

(*c*) **A Partial or Incomplete Monopoly** exists where a combination controls "as large a portion of the field of a

[1] *Monopolies and Trusts*, pp. 76–77.

particular business as to be able to restrain competition." The effect of this control is to render the conditions determining price different from those which prevail in a competitive market.

Monopoly Prices

A monopoly is so situated in regard to the market that it is able to control, entirely or in part, the supply of a commodity or service; and so prevent its price being determined in free competition by supply and demand. The monopolist is therefore in a position to fix *either* the quantity to be sold *or* the selling price, but he cannot fix both. If he fixes price, the public demand will determine the quantity which will be consumed at that price; if he fixes the supply, the market will determine the price at which that quantity will be absorbed. In practice, the aim of the monopolist is to adjust the supply to the demand in such a way as to afford him the greatest possible total net revenue; or, in other words, he aims at making the difference between his total receipts and his total expenses of production as large as possible. In determining the point of maximum net revenue, the monopolist will first endeavour to estimate the demand for the product. This will, of course, depend largely on the nature of the product. If it is a luxury, or a product for which substitutes are available, the demand will tend to be *elastic*, and changes in price will greatly influence the quantities consumed. If, on the other hand, the product is a "necessary," and more particularly if no substitutes are available, the demand will be *inelastic*, and price changes will not affect consumption to a great extent. By experience we can determine the varying quantities which the market will absorb at given prices. The next step is to estimate the expenses of production for varying quantities of product. If production takes place under conditions of *Increasing Return*, the greater the production the smaller the expenses of production per unit of product will be; whereas under *Diminishing Returns*, increased production

is obtainable only at increased cost per unit of product. Having therefore a scale of quantities and prices on the one hand, and a scale of expenses of producing those quantities on the other, the monopolist is able to estimate his probable profits on the sale of given quantities, and can thus arrive at an estimate of quantity which will yield the greatest net profit.

The possession of a monopoly does not therefore imply the exaction of the highest price the consumer will pay for a commodity or service. While it is true that, in the case of a commodity produced under conditions of Diminishing Return, it usually pays the monopolist best to restrict the output and sell a small quantity at a high price, in manufacturing industries, where Increasing Returns prevail, the monopolist secures a greater revenue by supplying a large quantity at a low price. Though, in theory, the monopolist can fix the price as he wills, in practice, there are limitations. Where a monopoly arises from a combination of producers in the "trust" form, the aim is usually to secure all the economies of large-scale production, by centralized control, concentration of production, increased specialization, and standardization. As this implies increased production and (usually) lower selling prices, the monopolist looks to the increased turnover and lower production expenses for his increased revenue. If, however, for other reasons, high prices are fixed, disturbing factors beyond his control may upset the monopolists' plans. The high prices will act as an invitation for rival producers to enter the field; they may lead to a combination of consumers which, by limiting the demand, may restrict the monopoly gain; they will stimulate the search for and use of substitutes; and they may lead to intervention and regulation by the State.

Price Discrimination and Differential Charging

It has been assumed so far that the same price is charged to all purchasers by the monopolist. But this is unfortunately by no means the case. The power to fix prices

has on many occasions been used by monopolists as a powerful weapon in ruthless and destructive competition. Where the monopolist is faced with competition in a particular area, prices *in that area* are cut, sometimes even below the cost of production, in order to stamp out competition, while the prices in other areas are maintained. By selling at exceedingly low prices, the monopolist is enabled to capture the market, thus forcing competitors either to stop producing or to sell out to the monopolist. In other cases, prices are cut in order to maintain sales in certain districts only where keen competition exists. The practice of the Standard Oil Company may be used to illustrate the principle. According to the United States Bureau of Corporations the prices charged by the company, after deducting freight, for illuminating oil in certain cities in December, 1904, were as follows: New York, 10·5 cents per gallon; Philadelphia, 8 cents; Savannah, 12 cents; Chicago, 8·4 cents. The company was enabled to maintain these prices owing to the fact that it sold direct to retailers, thus limiting the supply each retailer held; and, furthermore, that oil can be transported economically only in tank cars which involve heavy capital expenditure for plant to deal with oil so transported. These considerations acted as a deterrent against attempts to buy oil for re-sale in other centres.

It must not be assumed, however, that the principle of differential charging is in itself economically unsound. On the contrary it may, in certain circumstances, be a sound business policy; and the practice is prevalent in many branches of business. In some cases, discrimination is applied on a *personal* basis. It is, of course, not possible to charge each customer, or group of customers, a price equivalent to the maximum they would be willing to pay, since it is impossible to ascertain this amount. Some rough form of classification is, however, often adopted which will place those who are likely to be willing to pay high prices in a class different from those who are likely to be willing

to pay low prices only. Thus, doctors and dentists take the rental of the houses occupied by patients as a rough indication of their incomes and fix their scale of charges accordingly; similarly, opticians charge less to customers with a prescription from a hospital than to those coming from an eye specialist. In this way, the poor are able to obtain service which they could not receive if all were charged on a flat rate basis. Sometimes producers allow their customers to classify themselves, by producing two or more qualities of their product, the increased price of the better grades exceeding the difference in cost. Again, a soap manufacturer, for example, producing tablets of one grade may sell loose tablets at threepence each, while two tablets wrapped in paper in a cardboard box, are sold for a shilling; the richer customers buy the latter, while the poorer customers buy the former. Manufacturers selling directly to a retailer charge higher prices than when selling to wholesalers; and the general practice of selling goods in large quantities at lower prices than for small orders shows how far the principle of price discrimination is extended.

It may, indeed, be a sound financial policy permanently to sell part of the output at lower prices than the average cost of production. In the case of an electricity undertaking producing current for both light and power purposes, the fixed expenses depend upon the *maximum* demand for current, since sufficient plant must be installed to supply the largest quantity of current required at any one time. On an average in such undertakings, the fixed expenses which are more or less independent of output represent three-quarters of the total expenses; while the running expenses which vary with the output represent one-quarter. The heaviest demand for current occurs when light and power consumers are using the current simultaneously. The more current that is consumed at other periods the better will the plant be utilized and the lower the fixed expenses per unit of current consumed will be. A supply of current at a time which will lead to a better utilization of

the plant may justifiably be sold at a price less than the average cost of production, provided that the price covers the cost of running expenses, and leaves a margin for fixed expenses. The fixed expenses would have been incurred whether the current was sold or not; and by the sale at prices above the out-of-pocket expenses, the general burden of fixed expenses resting on other consumers is somewhat reduced. A somewhat similar policy of a temporary nature is sometimes pursued by manufacturers during periods of depression. When prices have dropped so that the selling price does not cover the expenses of production, goods continue to be produced so long as the sale price covers the running expenses and leaves some margin for fixed charges. Since the fixed charges remain, whether production is carried on or not, continued production entails a smaller net loss—since it contributes something towards fixed charges—than would be incurred by closing down.

The examples given above of differential charging are, however, on an entirely different plane and for purposes very different from those of a monopolist who pursues that policy and who uses it to secure increased control. When through this power the monopolist imposes conditions that scheduled retail prices only are charged for his products; that supplies are given only on condition that competing products are not sold; or that traders are boycotted unless they agree to comply with prescribed conditions, it is apparent that monopolistic control may be productive of grave dangers to society.

Factors Favouring Combination

One of the chief causes that have been conducive to the modern tendency towards amalgamation and combination has been the desire to secure the economies which spring from large-scale production. The large capital of a combine gives stability and power. It secures economy of labour through centralization and a more perfect division of labour.

There is economy in space and rent. One of the largest department stores in Paris had a rental of about £40,000 and a turnover of £6,000,000. A shop with a turnover of £6000 would be paying in rent very much more than £40, which is in the same proportion. There is economy in buying and selling and in freight charges. There is economy in the use of natural agents and of specialized machinery. There is economy in the utilization of by-products in carrying on allied or subsidiary processes, the elimination of unnecessary duplication, and in many other directions. All this leads to a reduction in the cost of production, which is one of the main factors in converting a small-scale business into a large one, and in combining many smaller units into the great firm.

Other factors also favour combination. Keen competition resulting in low prices may seriously cut into the profits of the competing firms. If rivalry results in "cut-throat" competition, business may actually be carried on at a loss. In such circumstances, it is in the interest of the competitors to come to some arrangement which will protect their joint interests. The large capital and command over resources possessed by a combine give it tremendous bargaining power, which enables it to secure both materials and transport on specially favourable terms. Tariffs also, by creating vested interests among the home producers, encourage combination for the protection of those interests. Lastly, the development of communications generally, has served to make combination easier, since it facilitates centralized control of widely separated plants and establishments.

Early Forms of Combination

But while the tendency towards combination in its different forms has been so marked in our own period, we must not assume that, like many other industrial and commercial problems, it is a product of the "Industrial Revolution." Examples of it can be found far back in history.

So long as industry and trade were purely local in character, the need for combination did not make itself felt. But with the widening of markets, and the pressure of outside competition, there came, naturally, the longing for monopoly, and the desire for amalgamation as a means to secure this end. This aim shows itself clearly in what are possibly the earliest amalgamations in the country—the merchant guilds. It has already been seen in Part I that mention of these guilds is found towards the end of the eleventh century, and that in the thirteenth century they had been established in almost one-half of the English boroughs. A merchant guild, by virtue of its charter, exercised control over the trade of a borough, and, in such cases as Newcastle, it had the right of selecting the civic rulers. The aim of the guild was to discourage—if not to prevent—competition in its own sphere. While stranger merchants were not actually prevented from trading in the borough, their dealings were strictly supervised, and they were compelled to pay dues and to submit to restrictions from which the guild members were free. While the guilds were thus monopolistic in character, the consumers were protected from the resultant evils. By the rules of the guild short weight, inferior quality, and speculation—such as the re-sale of goods in the same market at an increased price, or the holding back of goods for higher prices—were prohibited. It is difficult to say, however, how far this protection was effective in practice.

The next series of trade combines which stand out prominently in our history is that of the great trading companies. These companies, which were simply amalgamations of merchant adventurers, came into existence during the period when our foreign and colonial trade was beginning to develop. The economic policy of the day favoured monopoly, and could see no merit in free competition. The risks of foreign trade were considerable. Long voyages, storms, tempests, uncharted seas, attacks from pirates and from hostile natives, were part of a cumulative series of risks which could ill be borne by an individual merchant.

True, a ship safely in port after a successful voyage meant a fortune to the venturer, but failure would have crippled him. Partly, then, with the desire of establishing a monopoly, partly for mutual protection, and partly with the idea of spreading their risks, these merchants amalgamated their resources.

Exclusive trading privileges with certain parts of the world were sought for and obtained from the Crown, and the monopolies thus obtained were guarded with jealous care, The most important of these companies was the East India Company, trading east of the Cape of Good Hope; the Levant Company, trading with the Mediterranean and the East; the Guinea Company, trading with the west coast of Africa; and the Russia Company. These companies played a very important part in the development of our overseas trade, and it is exceedingly doubtful if at that period the efforts of individual traders would have been nearly so successful.

Modern Forms of Combination

In modern times the tendency towards combination was general for some years both in America and on the Continent before it appeared in England. It is perhaps partly for this reason that—learning from the mistakes of others—the English forms of amalgamation are superior to those of Europe and America. Producers combine for the purpose of increasing their profits; and the method by which it is aimed to achieve this end determines the nature of the combination. In general, however, all associations of producers gain from the closer relationship, through an increased dissemination of commercial and technical knowledge, through improved methods of marketing, through increased standardization and simplification, and, in some cases, through the establishment of research departments.

It has already been seen that combinations assume a great variety of forms; and may best be classified according as they more nearly approximate to the cartel form or to

that of the amalgamation. The general characteristics of these types have been already described. (See Chapter IV.)

The Cartel

A cartel consists usually of the combination of enterprises in the same branch of manufactures or of commerce. The different independent undertakings combine more or less voluntarily without yielding their rights, in order that they may be maintained on a profit-earning basis. Periods of depression or bad trade are most favourable for the formation of cartels, and hence they have been called the "children of distress." A firm does not like to surrender even a part of its independence if it can be avoided. But unrestricted competition, "cut-throat" prices, unregulated production, and the flooding of the market with unsaleable goods may well lead to the ruin of the competing businesses. To remedy such a state of affairs, a cartel is formed under which the competing enterprises transfer to the central body certain of their functions, such as the fixing of the sale price, the determination of the quantity of output of the individual firms, etc.

Obviously, the nature and power of the cartel depend on the extent of the transferred functions. They may therefore be classified on this basis as follows—

1. **Condition Cartel.** This is the simplest and most widespread form of cartel and is based on an agreement among the members fixing uniform conditions as to length of credit, terms of delivery, discount rates, etc. Though this is not a very effective form of association, yet it may help to remove some of the worst evils of competition.

2. **Quality Cartel.** This form, which is common in the textile industries and in other trades, such as coal and iron, fixes a standard quality for the various grades of the commodity sold. The differences in prices between the different grades are fixed and are binding on all members.

3. **Price Cartel.** Neither of the above forms is very effective in controlling competition; and both of them are

included in the price association which controls the selling price of the commodity produced. Such associations are probably more numerous than those of any other form. The disadvantages of the price cartel may be briefly summarized—

(*a*) It is seldom very effective and is rarely of lengthy duration.

(*b*) The agreement is not legally enforceable,[1] and is open to the evasion of the terms and conditions by members.

(*c*) Competition is not prevented, since certain firms supply a better quality of goods at the fixed price.

(*d*) Since the expenses of production of the members vary, a fixed selling price leaves an unequal margin of profit.

(*e*) Production is not restricted. Since the price is fixed each member tries to produce as much as possible with the result that the market is overstocked.

4. **Cartel for the Protection of Territory.** An association of this form binds the constituent firms to limit their selling area to former customers or to restrict their sales operations to specified areas. Examples of this form are common among shipping and forwarding concerns, which undertake to confine their activities to particular areas and to refrain from poaching in the territories of others. It is obvious that such agreements can be effective only if outside competition can be excluded. An example of this type of agreement on a national scale is afforded by the arrangement between the American Tobacco Trust and the Imperial Tobacco Company not to compete in each other's country.

5. **Cartel for Regulation of Output.** This form of agreement fixes the total aggregate production of the combined firms, and decides what the "quota" of each firm shall be. Producers who exceed the amount of their quota are heavily fined, while compensation is usually awarded to those who have not reached their quota. In cases where prices are considered to be too low for remunerative

[1] Such agreements are legally enforceable in Germany.

production, the aggregate production may be considerably restricted.[1]

6. Cartel with Selling Organization. While some of the forms of association outlined above may temporarily remove the worst features of competition, none of them can exclude competition for any length of time. This can only be done where the selling functions of the individual members are taken over by a centralized headquarters. The central selling agency must of necessity be a separate legal entity to enable it to make and enforce contracts:[2] its capital is small, and is held by the constituent firms in agreed proportions. Its chief function is to dispose of the products of the constituent firms; but it cannot dispose of goods in unlimited quantities. It must, therefore, have the power to determine the aggregate output and to fix quotas for individual firms as in the previous form. The member firms fix by agreement a basic "cost" price; and sell their products to the central agency at an agreed price, slightly higher than the basic price. In this way, profits arising from efficiency of production go to the firms making them. The central agency disposes of the goods to the best advantage, the resultant marketing profits being distributed among the individual firms in proportion to their quotas. This is the highest form of cartel, and its chief advantage lies in the fact that being freed from the work of selling, the members are enabled to concentrate their energies on production. Its chief danger is that it may abuse its power to fix prices so as to secure large profits at the expense of the consumer. Since high prices will, sooner or later, attract new competitors, even this form of cartel cannot permanently safeguard its members against competition.

With the exception of the last-mentioned form, which involves considerable capital expenditure, and elaborate

[1] As in the case of the arrangement for the restriction of the production of raw rubber.

[2] A good example of this type is the Central Selling Agency, Ltd., of Glasgow, formed to market the products of Messrs. J. & P. Coates, the English Sewing Cotton Co., Ltd., and Messrs. Listers.

selling organization, cartels are usually formed for short periods only. They are not stable in character, and during their continuance are continually threatened with disruption from internal and external sources. Each member remains in the cartel only so long as it offers advantages to him—when it ceases to do so, he will cut loose at the first opportunity. Each member is, of course, bound by the conditions of the cartel, which has power to inflict penalties for their breach. But the cartel may find it difficult to enforce such penalties, and in any case it is practically powerless against secret infraction of the conditions by members. The greater the number of functions taken over by the cartel the more will the members feel cramped in their individual development, and especially so where the cartel arranges the quantity of output. The more efficient and enterprising members will demand better terms, and if this is refused dissatisfied members may bring about the dissolution of the cartel.

And then there are the outsiders. It is obvious that the strength of the cartel depends largely on the proportion of firms who participate to those who do not. The greater the number of enterprises involved, and the more they vary in size, capital power, and equipment, the more difficult it is to form a cartel. There are always firms which will refuse to come in—either for economic reasons or from sheer obstinacy. In some cases the cartel tries to render the position of such "outsiders" untenable by cutting prices in their circle of customers. But, however successful they may be in this respect, the cartel has rarely the power to prevent new "promotions," especially when prices have been forced to a high level. Nor even when protected by tariffs can the cartel always prevent foreign competition; so that outside competition is always a source of annoyance and danger to the cartel.

Amalgamations

In the cartel form the individual firms, by retaining their productive independence, do not acquire any additional

productive economies as a result of their association. To attain these economies, a close fusion of the industrial units is essential, and this is provided by the form of combination known as an amalgamation.

This may take either of two forms—the *trust* and the *merger* or *fusion*, though the term "trust" is often applied to both forms.

Trusts. The trust form of combination originated in the United States with the formation of the Standard Oil Company in 1882. In this older form, the combining firms conferred a general power of attorney upon certain trustees, who operated the combined firms on an agreed policy. The constituent firms received in exchange "trust" certificates, guaranteeing them a proportionate share of the profits. This form of combination became inoperative in 1891, when the Sherman Anti-Trust Law declared such powers of attorney to be invalid. Repressive legislation, however, proved ineffective,[1] and the trusts were reorganized in a new form. In the modern forms of trust, centralized control is exercised over the constituent units through a *holding company* or by means of *interlocking* directorates.

In the formation of a modern trust, the usual method is to create a new *holding company* for the purpose of acquiring a majority of the shares with voting powers in each of the constituent companies, which are now called *subsidiary companies*. In some cases all the shares are acquired, but a majority sufficient to give control is all that is necessary. By reason of this control, the holding company is able to make its own appointments to the boards of directors of each of its subsidiaries, and thus control their policies. In this way, plants can be specialized, products standardized,

[1] The Clayton Anti-Trust Act of 1914 prohibited the practices of price discrimination, "tying" contracts, interlocking directorates, and the holding by one company of shares or stock in another. These restrictions have been evaded in one way or another: while the prohibition of agreements in restraint of trade has served to encourage the fusion of interests into great amalgamations, e.g. The Standard Oil Company is now a huge merger of some thirty-six constituent companies.

output controlled, and orders distributed so as to secure the most efficient and economical working. This form of trust has the further advantage, from the point of view of its organizers, in that the power of control exercised is much greater than is represented by the capital of the holding company. Since a majority holding only is necessary for purposes of control, a holding company can control subsidiaries with a total capital almost twice as large as its own.

A somewhat less efficient method of securing control is by the system of *interlocking directorates*. In this case, the constituent companies remain under separate control, but a unified policy is, to some extent, obtained through the interchange of directors. The extent to which this system is successful depends largely on the community of interests which exists between the individual concerns; and on the extent to which confidence and agreement prevail between the different directorates. In general, however, this system lacks stability, and is much less conducive to general efficiency than where the constituent concerns are subject to centralized control.

The Merger or Fusion. In this form there is a definite welding together of the constituent enterprises. This may result from a merger or consolidation of the different concerns through an interchange of shares; or a dominant concern may absorb a number of subsidiaries through the purchase of the whole of or a controlling interest in their shares. In either case the individuality of the constituent companies disappears and is absorbed in the dominant entity. This is the most effective form of combination for the purpose of securing economy and efficiency in production, since wasteful duplication can be avoided and a high degree of specialization secured. As already pointed out, the term "trust" is commonly used to cover all these forms of amalgamation, and it will be employed in this wider sense throughout the remainder of this chapter.

The trust differs widely from the cartel in its origin, aim, and structure. The spirit of enterprise which has converted

the small business into a larger one, and finally into a gigantic concern, does not end there. It is not merely the question of money-making; there is the pride of the organizer in the development of his personal power and reputation; the pleasure of seeing ideas realized in practice; and the triumph of new achievements which have done much towards the promotion of trusts.

The trust aims at uniting the largest possible number of firms into one complete unit, and thus increasing the production and sale of goods, while lowering the cost of production. It tries to protect the market against over-production by adjusting output to demand, while at the same time regulating the price.

In most combinations of the trust type, there is seen at an early stage the development of the desire for self-sufficiency. It is for this reason that a trust often combines different branches of industry, such as manufacture, trade, transport, and insurance. A trust first expands horizontally, taking in competitive enterprises, and then it grows in height and breadth. It tries to free itself from dependence on the producers of raw materials, or on the sellers of finished products. Thus, you may find a rolling mill acquiring the steel works which formerly supplied it with raw materials. It may then acquire its own blast furnaces, and further free itself from the suppliers of coal and ore by purchasing coal mines, coke ovens, and iron mines. In the other direction, the trust may acquire engineering works or shipbuilding yards to absorb its own products, or it may try to become independent in regard to transport by acquiring its own ships. In the case of the American Oil Trust, not only did the Trust buy up railway shares so as to gain control of the railway, but it had its oil carried at half the rate charged to its competitors, and the railway even agreed to pay them the excess charged to others, and furnish them with details as to quantities sent.

The trust is a higher form of combination than the cartel,

because in the trust the constituent firms lose their independence. All the members are linked up into one indissoluble entity. There can be no infidelity among the members, no breach of contract, no secret competition. Competition is directed against outsiders, and becomes very effective, owing to the advantage of large capital, better organization, and large-scale production possessed by the trust.

In comparing these two forms of combination, the cartel and the trust, we can look at them from various aspects. From the popular point of view, the cartel is usually regarded more favourably than the trust, because it maintains the independence of the units composing it. From the economic point of view, however, the case is different. The trust aims at securing all the economies of large-scale production. It results in unification of effort, centralization of control, more perfect organization, greater efficiency, and lower production costs. The cartel, on the other hand, gains none of these advantages, as the individual firms work independently on the same scale as before. It aims mainly at the abolition of outside competition and the fixing of an artificial level of prices for the preservation of weak firms; and in this way it is a hindrance to industry and progress. From the consumer's point of view, both forms are to be feared. The cartel exists for the purpose of keeping prices above the normal. The trust is in a position to reduce prices, but it may not do so. The tendency in both is to increase the profits of the entrepreneur, and the return to capital at the expense of the consumer.

Trade Associations

One other form of combination[1] must be noticed on account of its general prevalence, and that is the trade

[1] In addition to those already discussed, the following forms of combination may be briefly described—

A Pool is the loosest form of trust and under it a combination of producers agree to divide their output or profits on an agreed basis. Since (1) it permits each member to retain his industrial

association. This is a much looser form of association than either the cartel or the trust, and is formed in the general interests of the trade for the purpose of fixing prices and terms of sale. Each member makes an initial contribution to the funds of the association, and at subsequent periods contributes in proportion to his total sales. Returns are made periodically to an independent secretary, and these are not disclosed to other members. Penalties, which are imposed for breaches of agreement, go into the common fund, which is administered by trustees for the benefit of the trade as a whole. In some cases, members are guaranteed a fair share of the total orders. Where this is done, quotas are fixed in the usual manner and orders allocated in accordance with the quota. Sometimes, also, special rebates are given to customers who buy exclusively from members of the association. These associations sometimes render valuable services both to the trade and to the individual members. The common fund is used for the development of trade research; for collective advertising;

independence, and (2) removes competition by the distribution of profits, this would be an ideal form of trust if it were of a permanent and stable character, which unfortunately it is not. Such organizations are common in the transport industries of England, Germany, and U.S.A. An interesting example is furnished by the Canadian Wheat Pools. These are combinations of farmers governed by a Board which acts as a selling agency. When the crop is harvested the Board makes an advance payment—usually $1 a bushel—to the farmer, thus acquiring control over the crop. The Board then markets the entire crop and after deducting expenses, pays the remainder to the farmers. There is a separate pool for each of the provinces of Manitoba, Alberta, and Saskatchewan, and over 70 per cent of the total Canadian wheat crop is marketed through these pools.

A Syndicate resembles a pool in that it is a combination of producers to regulate output and price. Like the Canadian Wheat Pool it takes over the business of selling The constituent firms sell their output to the syndicate at a price fixed by the latter, which then sells the product at prices varying with the state of the market.

A Corner or *Ring* is a temporary combination of financiers or dealers who, having secured control of the available supplies of a commodity for the time being, artificially limit the amount available for sale in order to force up prices and secure greater profits.

A Community of Interests is somewhat similar to a pool in form, and consists of an agreement between firms to avoid further competition and to assist each other by loan of capital. As in the pool, the profits are clubbed together and shared in an agreed proportion.

for the provision of credit information; and for the collection and dissemination of technical and other useful information.

VERTICAL AND HORIZONTAL COMBINATIONS

Apart altogether from the type of organization in amalgamations it is necessary here to consider amalgamations in respect to the direction of expansion. Vertical and horizontal amalgamations have widely different effects upon production and upon the community.

Vertical Combinations. We may regard any particular manufacturing industry as consisting of a series of stages of which the basis is the provision of the raw material. Above this is a series of processes until we reach the finished product. After this comes the marketing, which in itself usually has many stages before the product reaches the ultimate consumer. Now, when a business expands into a stage higher or lower than that with which it was originally concerned, its expansion is said to be vertical. When, for example, a printing business takes over paper mills and manufactures its own paper, or when it sets up a publishing department to absorb its products, there is vertical expansion. The upper stages of such a "mixed" works do not have to worry about their supplies of material, which largely consists of the partly finished products of the lower stages, nor do the lower stages have to trouble about a market for their products. In many cases all the different stages, from the production of the raw material to the sale of the finished product, are included in a vertical combination. It is seldom, however, that in this type of organization attempts are made to secure monopolistic control.

The group of industries which serves best to illustrate the working of a vertical amalgamation is the iron and steel industries. At the present time, indeed, a rationalization scheme is under consideration, which will involve the complete reorganization of the British iron and steel industries on these lines. In this group of industries there

are iron-ore, coal, and limestone at the raw material stage: pig-iron and steel as intermediate products; while the range of finished articles is very wide, including machinery of all kinds, locomotives, steamships, guns, etc. Iron and coal mines are large users of the machinery and rails which come from the latter stages; the intermediate stages, such as smelting furnaces, are large consumers of machinery, while also they receive their raw material from the mines and pass on their products to the mills.

A vertical amalgamation in this group of industries can effect great economies in production. Production can be controlled at each stage and the output of the lower stages can be adjusted to the requirements of the upper stages. Scarcely anything requires to be bought except for the lowest stage; scarcely anything to be marketed except from the highest stages. An important feature is that the higher stages can rely on the quality of the material supplied to them from lower stages and its suitability to their requirements.

In furnaces and rolling mills, the materials to be handled are so bulky that all operations must be performed mechanically. By a system of hydraulic or electric cranes on internal railways, masses of metal can be moved quickly and easily from department to department. And just here comes in an important economy. In the iron and steel industry fuel is an important item. Under centralized control one heating of the metal can replace several, and the saving in cost is very considerable. The molten metal can be passed straight from the blast furnace to the converter, straight to the mills to be rolled into plates, rails, girders, etc. The utilization of waste products affords many economies. The waste gases of the furnaces heat and pump air for their own use; and have still a surplus energy which can be utilized for other branches. Employment is steady, and it is often possible to shift temporarily labour from one stage of work to another. The central authority is in a position to divert surplus stocks to areas where work is

slack, or relieve a branch which is overburdened by transferring work to one not so busy. The U.S. Steel Corporation, which has several sets of "mixed" works, obtains economies of transport and marketing in this way. Orders received are sent to the works that can best handle it, taking into account the suitability of its plant, the amount of work it has on hand, and its geographical position. One of the best-known examples of vertical combination in this country is that of Dorman Long, an engineering firm controlling supplies of coal, iron-ore, and limestone. An example from another field is furnished by the firm of Bovril, which has large cattle ranches in the Argentine and Australia, and which also markets its own finished products.

Enough has been said to show that the vertical form of amalgamation has great advantages for the producer in lowering the cost of production. The consumer also gains in that competition in the finished article is rendered keener between such amalgamations and prices are lowered. A reduction in selling price means an increase in demand where the demand is elastic; consequently there will be an increased demand for labour, and, in any case, employment will be steadier.

Horizontal Combinations. With regard to the horizontal form of amalgamation, the problem is more complicated. The object of such a combination is either to secure the economies resulting from large-scale production, and so reducing production costs, or it is to gain some form of control over the selling price of their product. Now from a reduced cost of production both producer and consumer should benefit. Whether the consumer benefits by a controlled selling price depends entirely upon the policy of those exercising the control. Thus, while horizontal amalgamations possess great possibilities of benefit to the public, they also are a source of danger. The danger lies in the tendency towards monopoly which exists in such amalgamations. Under modern business conditions a perfect monopoly is rarely possible, but a measure of control approaching

monopoly *is* possible. It must not be assumed, however, that such a monopoly will arbitrarily put up prices. If prices are very high sales will be small and the total profits also small. As has already been pointed out, however, the monopolist in fact tries to adjust the price so as to obtain not the highest possible profit per article but the highest total profit on all goods sold.

It must not, because of their potential dangers, be supposed that monopolies, as such, are harmful. In many cases, monopolies are in the best interests of the consumer, as in the case of municipal supply services. While, on the one hand, the monopolist generally takes a pride in sustaining the superior quality of his products, on the other hand, one of the most striking results of keen competition has been the wholesale adulteration of goods. Free competition does not even guarantee cheapness, but in some cases actually raises the cost of production, as happens when there are too many producers in an industry. Even, however, if a combine does raise prices, it cannot, as we have seen above, do so unchecked. If the price goes too high, substitutes will appear on the market; so that the selling price of the monopolized article is regulated by the price at which the most efficient substitute can be profitably sold. That this is so is shown in practice by the strenuous efforts made by monopolists to obtain control of the substitutes. British railway companies in their early period endeavoured to get control of the canals, which offered a cheaper method of transport, while the American Oil Trust tried to obtain control of the rival gas and electricity concerns.

Great Britain

In this country, as also in the United States, the agreements binding terminable associations for the regulation of prices and production, being in restraint of trade, are not enforceable at law. In Germany, on the other hand, such associations are legal. This divergence in law accounts for the fact that combinations in Germany assumed the cartel

form, while in those of the United Kingdom and America combinations of the trust type developed.

The tendency towards amalgamation in this country has made remarkable progress in recent years. The most prevalent form is that of the trade association which is found in almost every industry; and many people anticipate that the success of these bodies will lead to their further development towards the cartel form.

In the realm of transport railway amalgamation culminated in the re-grouping of British railways into four huge combines. In the banking world there has also been a series of amalgamations of the horizontal form. This is the inevitable outcome of a tendency which has been evidenced for the past sixty years. As a result of these combines the banking business of the country is now practically controlled by five banks. Fear was expressed at the time that these amalgamations would result in the exploitation of the public by virtue of a practical monopoly. There is no evidence that such has been or will be the case. On the other hand, it is clearly evident that in times of crisis strong united financial action is more easily decided on and enforced when the control of banking is in the hands of a few banks than when it is widely diffused.

In the textile industries nearly all the great amalgamations have grown out of "understandings" between the firms concerned. These have developed into federations and have eventually ended in complete fusion. This general tendency is specially strong in such industries as those of wool-combing, bleaching, dyeing and finishing. Each of the main branches carries on its business separately, and the fusions which have taken place are of the horizontal type. As a result the chief branches of the textile industry are now dominated by powerful amalgamations, the chief of which include The Lancashire Cotton Corporation; The Fine Cotton Spinners' Association; J. & P. Coates, Ltd., which is closely associated with the English Sewing Cotton Co., Ltd.; the Bleachers' Association; the British Cotton

and Wool Dyers' Association; the Bradford Dyers' Association; and the Calico Printers' Association. On the whole these combinations have worked successfully; though the early history of the Calico Printers' Association showed, however, that mere fusion in the absence of thorough organization and strong central control may only result in disaster. The most striking success in this field, perhaps, is that of Messrs. J. & P. Coates, Ltd. By a series of amalgamations spread over several years the firm has secured a very considerable control over the production and sale of sewing cotton. From the shareholders' point of view the result has been exceedingly satisfactory. From the consumers' point of view it is generally admitted that the public are supplied with a good article at a reasonable price, and a better article than if it were produced by a number of small firms. Macrosty, in his book *The Trust Movement in British Industry*, shows that the selling price is actually less since the amalgamation than the average price for the twenty-five years previous, in spite of the fact that increase in wages and in the price of raw materials have raised the cost of production.

The coal, iron, and steel industries combinations of both the horizontal and vertical type are common. There were formerly three powerful Welsh coal combines in the Cambrian Coal Combine, the United Anthracite Collieries, Ltd., and the Amalgamated Anthracite Collieries, Ltd., but the last two bodies formed a great merger in 1927. Dorman Long, Vickers, Sons and Maxim, and Armstrong, Whitworth & Co., are prominent examples of horizontal and vertical combination in these industries.

In 1926 the four firms of Brunner Mond & Co., the United Alkali Co., Nobel Industries, and the British Dyestuffs Corporation amalgamated by an exchange of shares to form the Imperial Chemical Industries Combine. Since then it has absorbed the Cassel Cyanide Co. and other concerns, so that at the present time this huge combine with an issued capital of £77,000,000 not only controls the

IMPERIAL CHEMICAL INDUSTRIES, LTD.

Investments (Shares and Debentures) in Subsidiary or Associated Companies

Notes. 1. Particulars of issued capital relate to ordinary shares if not otherwise specified. Reference is made to footnotes where capital is partly paid.

2. Holdings refer to company in immediate control except where stated, e.g. Imperial Chemical Industries holds 67·1 per cent of Ordinary Shares of Scottish Agricultural Industries (16) The latter holds 100 per cent of Alexander Cross (16 (*d*)) Ordinary Capital, which in turn controls Nutrimol Feed (16 (*d*) (i)).

Company	Total Issued Capital	I.C I. or Subsidiary Cos.' Holding	Holding Co. (%)
	£	£	%
Main Operating Groups			
Alkali Group:			
1. I.C.I. (Alkali)	14,197,965	14,197,965	100
Mort. Loan	83,341	—	—
General Chemical Group:			
2. I C I. (General Chemicals)	5,077,740	5,077,740	100
(*a*) Cassel Cyanide	352,500	352,500	100
(*b*) Castner-Kellner Alkali	1,000,000	1,000,000	100
(*c*) Chance and Hunt—			
5% Pref.	140,000	23,220	16·6
Ord.	140,000	125,080	89·3
3. Chemical & Metallurgical Corp.			
8% Pref.	100,000	100,000	100
Ord.	112,608	112,608	100
(*a*) English Gelatine and Phosphates	*a*43,919	*a*43,919	100
4. Cwmbran Chemical	50,000	50,000	100
Dyestuffs Group.			
5 British Dyestuffs Corp	4,775,580	4,775,580	100
6 British Alizarine	*b*532,000	*b*532,000	100
(*a*) British Synthetics—			
5% Pref.	6,000	6,000	100
Ord.	1,000	1,000	100
7. Scottish Dyes	316,002	316,002	100
8. Oliver Wilkins & Co.	24,370	24,370	100
Fertilizer and Synthetic Products Group:			
9. I.C I. (Fertiliser and Synthetic Products)	5,802,967	5,802,967	100
Deb Stock	*c*1,370,200	—	—
10. Refrigeration Patents—			
"A"	1,110	—	—
"B"	1,890	1,890	100
Def.	1,000	630	63

Company	Total Issued Capital	I.C.I. or Subsidiary Cos.' Holding	Holding Co. (%)
	£	£	%
Lime Group:			
11. I.C.I. (Lime)	807,780	807,780	100
Deb. Stock	*d*2,100	—	—
(*a*) Casebourne & Co. (1926)	400,000	*e*400,000	100
Leather Cloth Group:			
12. I.C.I. (Rexine)—			
6% Pref	99,931	2,773	2·8
10% Pref	99,955	2,925	2·9
Ord.	814,104	814,104	100
Metals Group:			
13. I.C.I. Metals—			
5% tax-free Pref	500,000	497,501	99·5
Ord.	4,296,750	4,296,750	100
(*a*) British Copper Manuf	1,500,000	1,500,000	100
(*b*) Elliott's Metal Co	1,500,000	1,500,000	100
(*c*) Allen Everitt & Sons, Ltd.			
6% Pref.	100,000	100,000	100
Ord.	200,000	200,000	100
(*d*) Excelsior Motor Radiator	50,000	50,000	100
(*e*) John Marston	103,000	103,000	100
(*f*) Lightning Fasteners	13,428	10,772	80·2
(*g*) Broughton Copper Co.	475,000	475,000	100
(i) John Bibby, Sons & Co (Garston)	8	8	100
14. Amal, Ltd.—			
7½% Pref.	133,898	62,376	46·6
Ord.	181,695	109,561	60·3
Explosives Group:			
15. I.C.I. (Explosives)	4,992,872	4,992,872	100
(*a*) Bickford, Smith & Co	200,000	200,000	100
(*b*) Brit. Elec. Detonator	6,000	5,975	99·6
(*c*) British Westfalite	10,007	10,007	100
(*d*) Curtis's and Harvey	428,250	428,250	100
(*e*) R. and T. Jack & Co.	10,000	10,000	100
(*f*) Lancashire Explosives—			
6% Pref.	5,000	5,000	100
Ord.	7,500	7,472	99·6
(*g*) Liverpool Magazines	16,300	16,300	100
(*h*) Nobel's Explosives—			
5% Pref.	1,000,000	1,000,000	100
Ord.	3,000,000	3,000,000	100
(*i*) Patent Elec. Shot Firing	10,000	10,000	100
(*j*) Roburite & Ammonal—			
10% Pref.	62,500	62,500	100
Ord.	78,340	78,340	100
(*k*) Sedgwick Gunpowder	30,000	30,000	100
(*l*) W. H. Wakefield & Co.	75,000	75,000	100

Company	Total Issued Capital	I.C.I. or Subsidiary Cos.' Holding	Holding Co. (%)
	£	£	%
Explosives Group—contd.			
(*m*) Alexander Walker & Co.	60,000	60,000	100
MISCELLANEOUS GROUP			
A. *Scottish Agricultural Section:*			
16. Scottish Agric Industries—			
6% Pref.	577,235	—	—
Ord.	822,226	551,443	67·1
Def	252,522	—	—
(*a*) Aberdeen Comm. Co.	*f*100,000	*f*100,000	100
(*b*) Barclay, Ross & Hutchinson—			
6% Cum. Part. Pref.	7,500	7,500	100
Ord.	12,500	12,500	100
(*c*) Cross Chemical	25,000	25,000	100
(*d*) Alexander Cross & Sons	266,000	266,000	100
(i) Nutrimol Feed	15,000	15,000	100
(*e*) J. & J Cunningham—			
5% Pref.	180,000	180,000	100
Ord.	220,000	220,000	100
(i) J. & J. Cunningham (London)	20,000	19,750	98·75
(*a*) John Adnams & Son	4,000	3,300	82·5
(ii) William Pattullo & Co.	3,000	3,000	100
(iii) Robt. Hart Anderson	3,000	3,000	100
(iv) Neptune Mills	1,700	1,700	100
Held jointly by Alex. Cross & Sons, Ltd., and J. & J. Cunningham, Ltd.:			
(i) Banff & Moray Agric	20,000	*g*20,000	100
(ii) Highland Agricultural	25,000	*g*25,000	100
(iii) John Milne & Co.	45,000	*g*45,000	100
(*f*) John Millar & Co. (Aberdeen)	165,000	165,000	100
(*g*) Charles Tennant & Co. (of Carnoustie)	60,000	60,000	100
(*h*) Daniel Wylie & Co	127,250	127,250	100
B. *Lighting Trades Section:*			
17. Lighting Trades—			
10% Pref	171,374	171,374	100
Ord.	17,650	17,650	100
(*a*) F. H. Taylor & Co.	2,883	2,883	100
18. Welsbach Light Co.	257,925	257,125	99·7
C. *Nobel Chemical Section:*			
19. Nobel Chemical Finishes—			
6% Pref.	150,000	150,000	100
Ord.	650,000	331,500	51
(*a*) Fredk. Crane Chemical	11,242	11,242	100

Company	Total Issued Capital	I.C.I. or Subsidiary Cos.' Holding	Holding Co. (%)
	£	£	%
D. *Australasian Section*:			
20. I.C.I. of Australia and N.Z.—			
7% Pref.	*h*671,746	603,877	89·9
Ord.	*i*1,646,954	*i*1,511,109	91·7
Def.	250,000	250,000	100
(*a*) Ammonia Co. of Australia	43,000	34,850	81·05
(*b*) Brunner Mond & Co. (Australasia) Prop'y. .	150,000	150,000	100
(*c*) Leathercloth Prop'y. .	400,000	204,000	51
(*d*) Nobel (Australasia) Pr. .	1,198,950	1,198,950	100
(*e*) Victoria Ammonia Co. Proprietary . .	10,000	8,000	80
E. *Other Miscellaneous Cos.*:			
21. Arthur and Hinshaw—			
7% Pref.	55,000	55,000	100
Ord.	30,000	30,000	100
22. I.C.I. Estates . . .	10,000	10,000	100
Debs.	1,261,920	—	—
23. I C.I. Savings Bank . .	2,000	2,000	100
24. Imperial Chemicals Insur. .	50,000	50,000	100
25. Lancashire Public House Trust			
Ord.	*j*5,908	4,317	73·1
Def.	*j*20	—	—
26. Mouldrite	*k*75,000	49,950	66·6
27. Paper Goods Manufacturing .	15,000	15,000	100
28. Portland Glass—			
6% Non-cum. Pref. . .	66,109	63,134	95·5
Ord.	17,749	10,656	60·0
29 Steatite & Porcelain Products			
7% Cum. Part. Pf. . .	120,000	98,900	82·4
7½% Cum. 2nd Pf . .	14,000	7,500	53·6
Ord.	60,000	37,024	61·7
Debs.	30,000	24,700	82·3
30 Thames House Estate . .	*l*1,000,000	575,000	*m*57·5
ASSOCIATED INDUSTRIAL INTERESTS OUT OF THE UNITED KINGDOM			
41. African Explosives and Industries	3,500,000	1,750,000	50·0
(*a*) Cape Explosives Wks.—			
Ord.	500,000	500,000	100
5½% Deb. Stock. . .	755,265	—	—
42 Canadian Industries—	$	$	
Pref. Stock . . .	4,650,000	*n*25,000	0·5
Com. shs. n.p. "A" . .	615,974	297,937	48·4
"B" . .	58,269	—	—
	Arg. Paper Pesos	Arg. Paper Pesos	

Company	Total Issued Capital	I.C.I. or Subsidiary Cos.' Holding	Holding Co. (%)
	$	$	%
43. Industrias Quimicas Argentinas "Duperial" S.A.	15,000,000	7,500,000	50·0
44. Magadi Soda Co., Ltd.—	£	£	
6% 1st Pref.	219,094	—	—
6% 2nd Pref.	328,047	13,767	4·2
12½% 5s. Pf. Ord. f.p..	57	—	—
12½% 5s. Pf. Ord., 3s. p.	149,829	92,527	61·8
Ord. .	100,000	100,000	100
6% Mort. Debs.	425,700	2,300	0·5
45. Cia. Sud Americana de Explosivos	400,000	169,575	42·4

Names of I.C.I. Foreign Merchanting Companies

31. Brunner Mond and Co. (Japan), Ltd 32. I.C I (Brazil), Ltd. 33 I C.I. (Chile), Ltd. 34. I.C.I. (China), Ltd 35 I C.I. (Egypt), S.A. 36. I.C.I (India), Ltd. 37 I C I (Levant), Ltd. 37*a*. I C I. British and Levant Agencies, Ltd 38. I.C I (Lima). 39. I C I. (Malaya), Ltd. 40. Kerlen and Co.

Investments in Industrial Companies

A. Allied Chemical and Dye Corporation B British Titan Products, Ltd. C. E. I. du Pont de Nemours. D General Motors Corporation. E. I.G. Farbenindustrie A G. F International Nickel Corporation of Canada. G. Joseph Lucas and Co , Ltd. H Murex, Ltd.

a 33,519 £1 f p ; 10,400 £1 shares, 10s paid.
b 232,000 £1 shares f.p , 300,000 £1 shares, 15s paid
c Notice to repay approximately £125,000 was issued in February, 1935.
d Notice to repay has been given
e Shares held by I C.I. (Fertilizer and Synthetic Products), Ltd.
f 20,000 £5 shares, £2 paid
g 50 per cent Cross; 50 per cent Cunningham
h 605,079 £1 shares f.p , 66,667 £1 shares, 1s paid
i 1,513,621 £1 shares f.p ; 133,333 £1 shares, 1s. paid.
j 5908 £1 shares, 15s. paid; 20 £1 deferred shares, 1s. paid
k 50,000 £1 shares f.p.; 25,000 £1 shares, 10s. paid.
l 350,000 £1 shares f.p.; 250,000 £1 shares, 10s. paid; 40,000 £1 shares, 1s. paid.
m On total shares. *n* Held by I.C I. Savings Bank

British chemical industry but is linked up with almost every important foreign chemical undertaking. The combine covers eight main groups covering general chemicals, fertilizers and synthetic products, dyestuffs, alkalis, explosives, leather cloth, lime, and metals. In addition it includes a miscellaneous group of undertakings, including Scottish Agricultural Industries with its subsidiaries and sub-subsidiaries and other concerns with interests ranging from the porcelain and lighting trades to insurance. "It will be observed that the combine has a footing in many countries (from China, literally, to Peru), and in trades as diversified as sporting cartridges and soda crystals, motor components and motor fuel, plastics and property ownership. By a series of links in a less tangible chain, varying in substance from closely definitive trade agreements to mere directorial 'contracts,' the group maintains an individual relationship with leading British concerns in the heavy trades, the engineering, electrical, and motor industries, the textile trades, and other important branches. Internationally, its connections, by shareholding or agreement, include the I.G. in Germany, General Motors, and Du Pont in the United States of America, International Nickel and Canadian Industries in Canada, and African Explosives (jointly controlled with De Beers) in South Africa. The modern world, indeed, under a regime of private enterprise, has produced no more perfect an example of 'planned economy,' centralized for policy and finance, decentralized in administrative functions, and armed at all points in its relations with suppliers, customers, competitors, and the State."[1] An analysis of the wide ramifications of this powerful combine is given in the accompanying diagram and chart. In a kindred industry, Unilever, Ltd., is a huge vertical and horizontal combination; while in the tobacco (Imperial Tobacco Co.); retail drapers (Drapery Trust, Ltd.); brewery (Bass-Worthington); distilling (Distillers Co., Ltd.), and

[1] *The Economist*, 19th January, 1935.

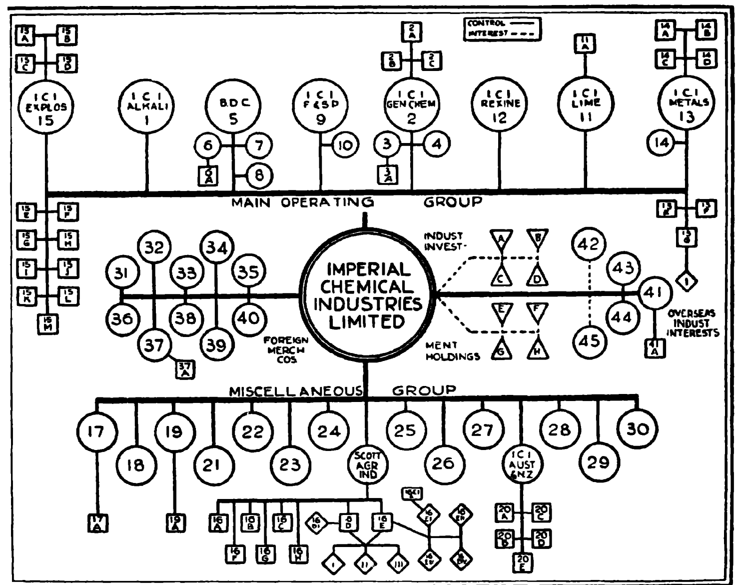


FIG. 10

REFERENCES TO CHART

○ Indicates subsidiary company, or direct associate of I.C.I. □ Indicates sub-subsidiary company, controlled by subsidiary and associated companies numbered 1 to 45. ◇ Indicates sub-sub-subsidiary company controlled by sub-subsidiaries, *e.g.* (13 (*g*)) and (13 (*g*) (i)). △ Indicates industrial investment interest without share or management control.

many other industries similar amalgamations are to be found.

The one industry in which the tendency to amalgamate has not appeared to any great extent is that of agriculture. The common cultivation and management of farms presents serious difficulties, and can only be carried out for farms that are contiguous. An important factor is the mental attitude of the farming class. Conservative in habits and methods, they are also prone to jealousy, so that close working is more likely to breed lawsuits than to develop amalgamations. It seems probable that any developments in this respect will lie along the lines of co-operation rather than that of fusion. Much has been done in this direction already. Our co-operative dairies have been most successful, and there is room for similar activities in the joint purchase of machinery plant and fertilizers in large quantities. Where amalgamation is required, however, more than in anything else is in the disposal of the produce. The large number of middlemen results in the farmer getting too low a price, while the cost to the consumer is relatively far too high. Some of the agricultural syndicates in France (of which there were about 3000 before the war) have successfully experimented in the joint marketing of wine, vegetables, and fruit; and a combination of dairy farmers for the joint disposal of their products in the London area has also been very successful. "Selling Associations" with their centralized control should eliminate much of the waste of the present system of marketing, and give the farmer a better return for his labour, while at the same time benefiting the consumer by lower prices.

America

In spite of all attempts at repressive legislation since the early establishment of the Standard Oil, the Whisky and the Sugar Trusts, the tendency towards combination has developed rapidly. Probably the most striking individual

amalgamation was that of the United States Steel Corporation in 1901, which centralized the control of more than half the total capacity for steel production in the country. At the present time there are about 200 big combines which between them control the great bulk of the industrial production of the United States. Such combines "control, more or less successfully, the production of tobacco, petroleum, sugar, linseed oil, iron and steel, copper, shipbuilding, beef, starch, flour, cotton-seed, candy, chewing-gum, candles, salt, ice, glucose, crackers, matches, whisky, anthracite coal, fertilizers, tin-cans, farming tools, locomotives, writing papers, school furniture, sewer pipes, glassware, rubber goods, buttons, leather and electrical supplies."[1]

GERMANY

In Germany the right of producers to combine for the purpose of regulating prices and conditions of production is legally recognized; and since 1902 the power of a combination to inflict penalties on its members for breach of agreement was made legally enforceable. Cartel organizations, aiming at stability of prices, developed rapidly from the beginning of the present century, one of the most powerful of these being the Rhenish-Westphalian Coal Syndicate, which was established in 1893. After the war the rationalization of German industry led to a closer fusion of interests than had existed under the old cartel system. This resulted in the development of the trust form of organization through the operation of holding companies or through amalgamation. In the earlier stages these new combinations were of the "vertical" type, but more recently there have been many "horizontal" combinations, particularly in the coal, iron, and steel industries. The Vereigigte Stahlwerke A.G., a huge steel trust formed in 1926 by the union of four coal and iron combines, is the largest on the Continent. In other industries the same tendency prevails as is evidenced

by the formation of a powerful trust in the dye industry, the I.G. Farbenindustrie A.G.

INTERNATIONAL COMBINATIONS

In general the existence of the same conditions which have operated in favour of national combinations have also tended towards the creation of international agreements. These conditions are, briefly, excessive competition, increased profit-earning capacity through reduction of costs, and the need for organized research. In the case of international combinations the creation of arbitrary political frontiers without regard to natural economic conditions is an additional factor of considerable importance in some cases. Where there is unbalanced production and excessive price movements it is impossible to maintain the full and constant employment of plant which is essential to economical production; while cut-throat competition reduces or destroys the margin of profits. Given the operation of one or more of these causes the conditions favourable to the formation of international combines have been summarized[1] as follows—

1. The existence of a small number of producing organizations.
2. The natural scarcity of a commodity, or the concentration of supplies in a limited number of regions.
3. The existence of national combines having authority to negotiate on behalf of their member firms or shareholders.
4. Where various governments regard the formation of an international combine as likely to further the interests of their respective states.
5. The existence of international financial interlacing.
6. Where the commodity produced is a raw material or in the early stages of manufacture.

Of course not all of these conditions are operative in a particular case, but in general the formation of an

[1] Plummer, *International Combines in Modern Industry*, p. 55.

international combine is assisted by the existence of several of these causes in combination.

Though there were a number of international combines in existence in the nineteenth century,[1] their growth may be correctly characterized as a development of the twentieth century. In 1897 German interests participated with those of Britain, France, Belgium, or Austria in some forty international combines;[2] while in 1914, there were 114 known international combines covering coal and metals, chemical, transport, textile, stoneware and porcelain, paper, cement, electrical, and other industries. The impetus given by the war, together with the amazingly rapid advances of science and technique, by creating an enormous increase in productive capacity intensified international competition and accelerated the movement towards international combination. In the main these combines are concerned with raw materials and basic manufactures such as nitrate or raw steel, but there is evidence that the movement is expanding to include manufactured goods. While these combines are monopolistic in character there are very few which have succeeded in obtaining a monopoly of the world market though some have attained a virtual monopoly. The International Cyanide Syndicate, for example, controls 92 per cent of the world's output; while only 1 per cent of the magnesia-producing firms of Germany, Czechoslovakia, England, and Italy are outside the international magnesia combine,[3] but for the most part these combines are limited in scope and many are very loosely bound together.

These combines may be either of the cartel or of the trust type. With the former may be included international agreements for the control of output; while in the latter we must distinguish between "the concern" and "the fusion." In

[1] The Neckar Salt Union (1828), which formed an agreement in 1867 with the Eastern French Salt Works Syndicate; and the Nobel Dynamite Co. Ltd. (1886), which combined interests in England, Germany, Switzerland, Mexico, and Brazil, are examples.

[2] Plummer, *International Combines in Modern Industry*, p. 3.

[3] *Ibid.*, p. 13.

the concern the international undertakings remain legally independent but form one unit under a central control. The fusion, of course, involves the complete merger and ownership of the constituent companies. Combines of the cartel type aim at securing the preservation of the home market for each national group; a division of "export territories"; the regulation of prices; regulation and restriction of output and exchange of technical information. International trusts achieve all these ends and in addition secure concentration of production, the elimination of inefficient units, and the standardization and simplification of products.

It is not possible here to do more than refer to the vast and intricate network of interests, both financial and industrial, which have developed as a result of international combines in many industries. The electricity supply industry, the artificial silk industry, sewing machines, gramophones, condensed milk, and many other industries are the subject of great international combines of which "Standard Oil" and "Imperial Chemicals" are well-known examples. Unilever, Ltd., the great international trust, apart from its enormous English interests, besides controlling the greater part of the margarine industry in Europe and possessing interests in oil-crushing and refining factories and allied industries in all the chief European countries, holds a controlling interest in the United Africa Co., Ltd., which in turn holds controlling interests in more than sixty companies carrying on operations all over the world.

As an indication of the ramifications of these great combines we may take an illustration from the oil industry where the interlacing interests are less perplexing than in some of the industries mentioned above. "The Royal Dutch Petroleum Co., for example, and the Shell Transport and Trading Co., Ltd., have been in close combination since 1907 in the production and marketing of petrol and oil. Besides the British and Dutch shareholders in this combine, French and American investors acquired holdings of its

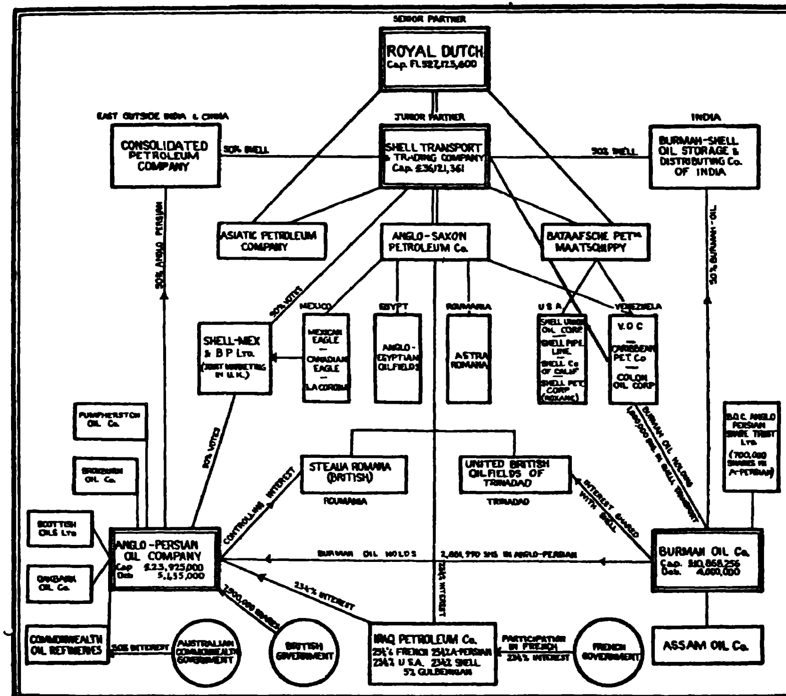

SENIOR PARTNER
ROYAL DUTCH
JUNIOR PARTNER
SHELL TRANSPORT & TRADING COMPANY
EAST OUTSIDE INDIA & CHINA
CONSOLIDATED PETROLEUM COMPANY
50% SHELL
INDIA
BURMAH-SHELL OIL STORAGE & DISTRIBUTING Co. OF INDIA
50% SHELL
ASIATIC PETROLEUM COMPANY
ANGLO-SAXON PETROLEUM Co.
BATAAFSCHE PETm MAATSCHAPPY
50% ANGLO PERSIAN
50% BURMAH-OIL
50% VOTES
MEXICO
EGYPT
ROUMANIA
U S A
VENEZUELA
SHELL-MEX & B P LTD.
(JOINT MARKETING IN U.K.)
MEXICAN EAGLE
CANADIAN EAGLE
LA CORONA
ANGLO-EGYPTIAN OILFIELDS
ASTRA ROMANA
SHELL UNION OIL CORP
SHELL PIPE LINE
SHELL Co OF CALIF
SHELL PET CORP
(ROXANA)
V.O.C
CARIBBEAN PET. Co
COLON OIL CORP
BURMAH OIL HOLDING
PUMPHERSTON OIL Co.
BROXBURN OIL Co.
STEAUA ROMANA (BRITISH)
ROUMANIA
UNITED BRITISH OILFIELDS OF TRINIDAD
TRINIDAD
B.O.C. ANGLO PERSIAN SHARE TRUST LTD.
(700,000 SHARES IN A-PERSIAN)
50% VOTES
CONTROLLING INTEREST
INTEREST SHARED WITH SHELL
SCOTTISH OILS LTD
ANGLO-PERSIAN OIL COMPANY
Cap £23,925,000
Deb 5,155,000
BURMAH OIL HOLDS
BURMAH OIL Co.
Deb. 4,000,000
OAKBANK OIL Co.
23¾% INTEREST
23¾% INTEREST
COMMONWEALTH OIL REFINERIES
50% INTEREST
AUSTRALIAN COMMONWEALTH GOVERNMENT
BRITISH GOVERNMENT
IRAQ PETROLEUM Co.
23¾% FRENCH
23¾% U.S.A. 23¾% SHELL
5% GULBENKIAN
PARTICIPATION IN FRENCH
23¾% INTEREST
FRENCH GOVERNMENT
ASSAM OIL Co.

FIG. 11

stock. The original centre of its operations was the Dutch East Indies, but its activities soon spread. It acquired oil-fields and refineries in other countries and steadily built up a wide-flung distributing organization, so that to-day it has important interests in oil undertakings throughout the world, and controls approximately 10 per cent of world production. In conjunction with the Anglo-Persian Oil Co. and the Deutsche Bank, the Royal Dutch Shell combine acquired the Turkish Petroleum Co., now called the Irak Petroleum Co. Its American subsidiary, the Shell Union Oil Corporation, has recently made considerable headway in the United States market, while as regards oil distribution in India, China, and other eastern countries, the Royal Dutch-Shell and the Anglo-Persian-Burma groups are as one. In Great Britain these companies market their products through a common organization known as Shell-Mex and B.P., Ltd."[1]

The Control of Monopoly

It is generally admitted that monopolistic power in the hands of producers is a potential social danger in that it may be used in a manner detrimental to the interests of the community. It is also admitted that for this reason some measure of control over monopolies is necessary; though opinions differ widely as to the form such control should take. It is necessary, therefore, to examine the existing or suggested safeguards against the abuse of monopolistic power. It has already been noted (*ante* p. 143) that the monopolist's power to fix extortionate prices is not absolute, but is controlled by certain limitations. To what extent are these limitations effective?

(*a*) *Substitutes.* The use of substitutes may limit monopoly price provided they are not also controlled by the monopolist. In any case the consumer will suffer inconvenience through their use.

[1] Plummer, *International Combines in Modern Industry*, p. 6.

(*b*) *Potential Competition.* American experience has shown how a powerful monopoly can use many weapons to render the position of new competitors untenable. Should the competitor be able to withstand these his business can be absorbed by the monopolist on favourable terms. The large amount of fixed capital required in modern industry will deter capitalists from investing in a concern which will have to fight against a monopoly.

(*c*) *Competition Between Combinations.* Where this becomes so effective as to cut seriously into profits a new association or amalgamation will come into existence.

(*d*) *Foreign Competition.* Tariffs may prevent this from being effective, but if not international agreements can overcome competition.

(*e*) *Consumers' Combinations.* Where, as in this country, the co-operative movement is highly developed, this may prove a useful check. It is, however, difficult to initiate a new movement, and if the monopolized commodity is a "necessary" this competition will be largely ineffective.

State Regulation. It can be seen that while certain safeguards against the abuse of monopolistic power exist, these are, in the main, weak and ineffective. Until such times as an effective "social conscience" has been developed by producers to an extent that will justify their being entrusted with the consumers' welfare, some form of State regulation would seem to be necessary.

The method of *repressive legislation*, where it has been tried, has proved a failure. Its only result has been to encourage a search for new devices for evasion of the law, which is eminently undesirable. Whether combinations are good or bad it must be recognized that they have a definite place in modern industry, and that they have come to stay. Legislation will not *abolish* them.

An obvious solution to the problem that at once presents itself is the fixation of prices by the State. The practical difficulties of such a course are, however, enormous. What would be "reasonable" prices under one set of productive

and market conditions would be absolutely "unreasonable" prices under different circumstances. The fixing and checking of a reasonable level of prices would involve the establishment of a huge State department of accountants and cost accountants, and this would entail heavy expenditure. The plan of taxing "excess" profits, which was tried as a war-time measure, offers little hope of effective control. Even if a 60 per cent tax is levied, the monopolist is still 40 per cent of the excess richer than if he had charged reasonable prices; while the consumer pays for the whole 100 per cent. The expediency of limiting the rate of profits has also been suggested. Here again the difficulty presents itself of fixing a "reasonable" level of profits. The calculation of profits abounds in accountancy intricacies, and it is easy to disguise profits by building up "reserves" which are subsequently capitalized. Apart from this, however, there is a real danger involved in this method. Since the increased profits of large-scale concerns are in many cases due to improved organization and methods, the fixing of an arbitrary level of profits would in effect be imposing a tax on efficiency. There is a possibility that a measure of control could be secured by linking up prices and profits, as is done in cases where gas monopolies are leased to private concerns. In this case an increase in the price of gas must be accompanied by a decrease in the rate of dividend; and the rate of dividend can be increased only if the price of gas is reduced. Probably, however, the most effective control would result from the imposition of an obligation not only on combinations, but on industrial concerns generally, to afford greater publicity as to their activities. "Greater publicity would serve three useful purposes. By making known the profits of business concerns, it would stimulate the flow of enterprise and capital into industries in which the demand was greater than the supply; by bringing the operations and effects of combinations into the light, it would relieve many unfounded suspicions on the part of the public; and by assuring that extortion would be

publicly pilloried, it would do much to prevent its being practised."[1]

There is a marked tendency in modern industry and commerce for the business unit constantly to increase in size and for individual units, by amalgamation, to become still larger. If this evolution should continue in the future what will be the result? It will inevitably involve the gradual disappearance of all who carry on a business or industry for themselves—the small shopkeeper, the small manufacturer, the small merchant. These persons, now independent producers, would become wage-earners, employees of immense enterprises capitalized in millions of pounds.

Such a prospect is not gratifying to the ordinary individual, but it is pleasing to some economists and to all collectivist socialists. To them the economic evolution which is taking place in our time appears to involve three successive stages: (*a*) competition among small producers, (*b*) monopoly control of large producers, (*c*) State control. The collectivists in particular declare that this evolution is inevitable, and that efforts to hinder it will be of no avail. Every change by which small businesses are replaced by large concerns, and by which individual production gives place to large-scale collective production, is regarded as a step forward on the road to collectivism. From this point of view small-scale production and individual enterprise are things to be despised. Such is the opinion of Karl Marx, who says, "This system excludes concentration, co-operation on a large scale, the extensive use of machinery, the wise rule of man over nature, agreement and unity in the purposes, the means and the efforts of collective activity. It is compatible only with a rudimentary state of production and society. To perpetuate such a system of isolated production would be to decree mediocrity in all things."

[1] Committee on Trusts: *A Study of Trade Organizations and Combinations in the United Kingdom*, by John Hilton.

It is just as impossible to agree with this sweeping condemnation as it is to admit that the suggested evolution is inevitable. It must be remembered that while certain "service" industries such as gas, water, tramways, etc., are essentially suitable for government control because their products are uniform, and are not subject to the risks of marketing or to foreign competition, these conditions do not apply to industry generally. The production and marketing of goods which are to be sold in widely separated foreign markets under keenly competitive conditions involve special problems for the solution of which the machinery and atmosphere of a State department are but ill adapted.[1] If State control of industry and commerce should, however, materialize, we would be swamped by bureaucracy and smothered by taxation. The heavy hand of Government tends to slacken progress in whatever matter it touches. The incentive to strive, to plan, to experiment, to take risks will disappear. The worker would find that the "greater freedom" towards which he was striving had culminated in the conscription of labour, and harassed humanity would be glad to revert to the system of private enterprise and commence the circle all over again.

Large-scale enterprises cannot go on expanding indefinitely. In their development a point is reached sooner or later where the economies of large-scale production are counterbalanced or overcome by wastage, leakage, and expenses. The business or industrial genius who gave them birth is replaced by a less efficient successor and development ceases or is replaced by retrogression.

On the other hand, the small business is not so impotent or out of date as it is supposed to be. The very existence of the larger business offers opportunities for the smaller. In production, where the earlier stages require large capital and much machinery, the latter stages may be mainly done by hand, requiring the attention that is best

[1] The problem of State Control of Industry is discussed in Chapter IX.

given by a small employer. The small builder buys ready-made doors and window frames, the small cutler buys his material from large steel firms; the small cycle shop builds excellent bicycles from machine-made standardized components; and in many other directions the large business is enlarging the scope for the initiative and for the watchful care about details in which the small producer excels.

The small producer and the small trader is constantly threatened with extinction by the larger firms. He has been driven from some branches of industry, yet he survives. And not only so, but the number of small businesses is constantly growing. It is a good thing for the community that this is so, for the small business affords an excellent training-ground for the development not only of initiative but of that capacity for detail which is so often lacking in those who have been trained in a large-scale undertaking.

CHAPTER VII

FLUCTUATIONS IN INDUSTRY

SEASONAL AND OTHER FLUCTUATIONS

IN the course of the year every industry is subject to seasons when business is booming and to seasons when work is slack, to periods of inflation and depression. Every branch of industry and commerce must be affected by the course of the seasons, and other such periodically recurring causes. But these periods of boom and depression from such causes are known in the different industries, and preparations can therefore be made beforehand to cope with them. Merchants and manufacturers are necessarily well acquainted with the seasonal fluctuation which takes place in their own branch of industry, and accordingly make allowances for such variation. They can use the slack season for perfecting and extending their organization, so as to be prepared to take full advantage of the season of boom when it comes. It is a fortunate circumstance that these seasonal fluctuations vary with the different industries, so that what is a busy season in one industry is a slack time in another, and that consequently throughout the industrial community such fluctuations tend to neutralize one another.

But while merchants and business men make preparations for fluctuations of this kind as a matter of course, history has shown us that, in the past, fluctuations of a much more serious character and affecting every branch of industry have taken place for which no preparations were made. From time to time the great commercial nations of the world have been exposed to serious depressions in trade, accompanied by a disorganization of their commercial, industrial, and financial machinery.

Nor have these depressions occurred during periods of bad trade alone, when they might reasonably have been

expected. In practically every case they have taken place in the midst of seasons of the greatest apparent prosperity, and at times when trade was at its best, and had every sign of continuing so. The periods of depression came in the seasons of boom, and the consequent shock intensified the resulting evils. Prices which had risen during the period of prosperity fell with great rapidity. Distrust and uneasiness showed themselves in business circles; men endeavoured to borrow money or to obtain it by selling goods at ruinous prices. A panic occurred in many cases in the money market, and industry and commerce found themselves in the midst of a period of stress and crisis, in utter ignorance of the causes which had brought about such results.

If such disturbances of trade could be traced to clear and well-defined causes preparations could be made to meet and deal with them as they arise, so that even if they could not entirely be prevented many of the evils resulting from them might at least be obviated. Little can be done to remedy the effects while the causes remain unknown. It is impossible to treat a disease successfully as long as the evil from which it springs remains undiscovered; and only when we have found out the causes underlying industrial and commercial crises can we hope to grapple with them and combat their effects.

During the last two centuries, serious disturbances took place in the years 1753, 1763, 1772–3, 1783, 1793, 1804–5, 1815, 1825, 1836–9, 1847, 1857, 1866, 1879. Of these years the most marked depressions took place in 1804–5, 1815, 1825, 1836–9. It can be at once seen that these periods of depression have taken place with marked regularity; and their average period of recurrence has been estimated to be 10·4 years. Since 1879, however, all traces of this periodicity have disappeared, the worst years being 1886, 1893, and 1908. Various causes, such as wars, etc., could be assigned as to the direct cause of each, but none of these in any way explains their periodicity.

The crises of the eighteenth century exhibit features

differing in many respects from those of the nineteenth, from their having taken place at a time when the methods of conducting commercial and financial business differed greatly from those now in use. They were primarily all due to the absence of State control over private banking, and to the unsatisfactory state of the currency. By the Industrial Revolution, moreover, the whole character and structure of industry was so entirely changed that there were few features left common to both periods. Consequently, while the crises of the eighteenth century are of historical interest they possess little value in an inquiry into the causes of cyclical fluctuations in modern times. An examination, however, into the features common to the cyclical fluctuations since the end of the Napoleonic wars may lead to a discovery of the causes which precipitated them, and this in turn to the discovery of remedies.

Crises and Depressions

It is necessary, however, first to remove a common cause of confusion which arises from the failure to distinguish between *crises* and *depressions*.

"The word *crises* describes a brief period of acute disturbance in the business world, the prevailing features of which are the breakdown of credit and prices and the destruction of confidence. It has especially to do with the relations of debtor and creditor. The word *panic* describes a different phase of the same general condition—a situation which is essentially mental or psychological.

"The term *depression* or *period of depression* describes a disturbance of much longer duration, and which cannot be designated as financial. It pertains rather to industry, and includes the whole field of production and exchange. It is properly described as industrial and commercial." [1]

We are apt to underestimate the tremendous importance of the part played by credit in the modern organization of

[1] T. E. Burton, *Financial Crises and Periods of Industrial and Commercial Depression.*

industry and trade. The whole fabric of production and exchange is based on the use of credit, and without it the present development of national and international trade would have been impossible. The element of faith, of belief, of confidence, or, in other words, of *credit*, has become so developed in the modern business world that business men normally accept promises to pay or orders of payment instead of actual cash as a matter of course. They are willing to do so as long as they have confidence that those promises or orders will be made good. When anything happens to weaken or destroy that confidence they are no longer willing to take the promise for the performance—they will not accept credit instruments in payment, but demand cash. When, therefore, some event or combination of causes has given a sudden shock to confidence, creditors become suspicious of the ordinary credit currency of commerce and demand cash, which debtors find a difficulty in obtaining. The sudden contraction of currency causes a temporary breakdown of the ordinary financial machinery, that is to say a *crisis*. Crises usually mark the close of periods of exceptional trade prosperity, but they may occur during a period of depression; while, on the other hand, the cycle of expanding trade and its subsequent depression may be unmarked by a crisis.

While a crisis is marked by a difficulty in obtaining money and a high rate of interest, an industrial depression is marked by a low interest rate. The essential feature of a depression is the inability of producers to market their goods at remunerative prices. When this happens, production is reduced, unemployment increases, and trade stagnates until a "scarcity demand" forces up prices to a level which encourages production.

Outstanding Features of Crises and Depressions in the Nineteenth Century

1815. This followed immediately the conclusion of the Napoleonic wars. During the long struggle the drain on

men and material from Great Britain was exceptionally heavy, as was also the burden of taxation. With the opening up of Continental markets a boom in trade was anticipated and much speculative production took place. But Continental markets had not really been closed to British goods, owing to the prevalence of smuggling during the war, and on its conclusion Continental countries began to use steam and machinery in their industries. Prices in this country had been very high while they were low on the Continent. When the expected boom did not materialize those who had pledged their credit in speculative production found that goods could only be sold at a loss, or were quite unsaleable. Conditions in agriculture were, if possible, in a worse state. There was a general collapse of credit; many note-issuing banks failed, and acute trade distress was accentuated by a sharp fall in prices caused by an over-abundant harvest. The resulting deflation enabled the Bank of England to resume specie payments in 1819.

1825. England adopted the gold standard in 1816, and in the years following there was a remarkable expansion of trade. The iron, coal, cotton, and woollen industries developed greatly, fortunes were accumulated rapidly, and there was great prosperity throughout the country. Speculation ensued, and spread throughout the community. Owing to the great increase in bank-notes [1] under the Act of 1822 money was cheap, and this further encouraged speculation. The capital required for the mining and industrial companies floated and for "investments" in foreign loans[2] was far greater than the country could provide. As the "calls" of unpaid capital became due increased accommodation was required of the banks, but a series of bank failures compelled the Bank of England to increase its rate to 5 per cent. A panic ensued. The note issue was everywhere reduced; credit was restricted, so that it was

[1] The note issue in 1825 was three times that of 1822

[2] During the years 1824–5 the capital investments are estimated to have exceeded 200 million pounds.

practically impossible to discount bills, and speculators were forced to relinquish their holdings. Seventy banks failed inside six weeks, and numbers of commercial houses collapsed. The Bank of England was forced to issue £1 notes to provide currency and prevent financial ruin to the country.

1836–39. This was a financial rather than an industrial crisis and caused only a slight derangement of trade. Trade and industry had prospered. Wild speculation in the United States affected Great Britain by inducing speculation in American cotton. American enterprises were mainly carried on with borrowed capital, a large part of which was British. A crisis in U.S.A. spread to England. The Bank of England attempted to protect its reserve by decreasing its note issue, but other banks increased their issues. The failure of a large Irish bank precipitated the crisis. When, in 1839, it was realized that investments in American loans could not be recovered a disastrous series of failures of private note-issuing banks took place.

1847. It was believed that the Bank Charter Act of 1844, by controlling the note issue, would prevent the recurrence of crises. The new era of cheap food and free trade had brought great prosperity. The desire for improved communication led to extensive speculation in railways.[1] As in the years preceding 1825 the public did not realize the necessity of maintaining an equilibrium between "consumption goods" and capital expended on work of permanent utility but of slow returns. When this disproportion was accentuated by reckless gambling in shares a crisis was inevitable. The shortage of funds on the money market led to a contraction of credit. During the period when the gambling in railway shares was at its height, the rate of interest was only $2\frac{1}{2}$ per cent, but it rose steadily to 8 per cent. The crisis might not have had

[1] In one session alone the Bills for railway construction before Parliament involved a capital expenditure of 340 millions sterling. In 1845, when account is taken of new issues selling on the market, the amount cannot have fallen short of 500 million pounds.

serious consequences had prices remained moderate. But the failure of the Irish potato crop, a poor cotton crop in America, and a bad harvest in England drove up prices threefold, resulting in unemployment and acute distress. The prospects of a good harvest had induced considerable gambling in corn, and the failure of the harvest caused the collapse of many commercial houses and the failure of several banks. Credit was severely shaken, while the general anxiety resulted in the hoarding of coin and bank-notes.

The knowledge that the Bank of England had obtained powers to suspend the Bank Act was sufficient to restore confidence, so that the Bank was not required to exercise the power obtained.

1857. The period following 1847 was one of remarkable industrial development. Increased transport facilities helped to produce unexampled prosperity. Development in U.S.A. was so rapid that even with the great increase in gold supplies from the new discoveries in California it was impossible to cope with the demand for capital for agricultural, manufacturing, mining, and railway enterprise. Most of these new enterprises were carried on with borrowed capital, and the banks by mismanagement intensified the danger. They lent in excess of all reason during the boom, but at the first signs of crisis they precipitated matters by calling in loans and increasing the rate of interest to 25 per cent. Business came practically to a standstill, the interest rate rose to 60 and 100 per cent; there was an enormous number of failures, eighteen banks closed down, while several railway companies suspended payment.

Meanwhile, similar causes had been at work in England. The great supply of gold from California had given over-confidence to speculators, and the end of the Crimean War brought a sudden drop in prices. American conditions produced results in England similar to those of 1836–39. With the drop in American securities, houses connected with

the American trade failed. This was followed by the failure of many British banks and a succession of bankruptcies. The drain on the Bank of England reduced its reserve to less than half a million, and the bank rate was increased to 10 per cent. A panic set in, which was only allayed by the suspension of the Bank Act.

1866. This was purely a financial crisis, though its immediate effects were felt by industry, but it was not accompanied by trade depression. The cotton famine in Lancashire caused by the American Civil War was a factor in retarding trade recovery, though this was compensated by the increasing demand for English goods. The use of inconvertible paper money in the U.S.A. had driven gold to Europe, so that abundant capital was available in England. The flotation of new companies was followed by much speculation, and many firms of bill discounters engaged in company promotion of a hazardous and speculative nature. A deficient harvest, a crisis on the Continent, and adverse exchanges combined to contract credit, and for three months the bank rate remained at 10 per cent. As a result of financing speculative enterprises, the great firm of Overend, Gurney & Co., whose bills were universally accepted as currency, crashed on 10th May with liabilities exceeding £10,000,000. Though the Bank, on 11th May, made advances amounting to £4,000,000, this was insufficient to allay the panic, and the Bank Act had again to be suspended before confidence could be restored.

1879. The years 1870–72 were marked by great prosperity in England. The transference of capital to England as a result of the Franco-German War led to heavy speculation, particularly in foreign loans. The subsequent flow of gold to Germany caused a contraction of credit. The American crisis of 1873 had resulted in a great decrease of our American trade, while the Russo-Turkish War increased our difficulties. The enormous losses on American, Bavarian, Turkish, and Egyptian investments, followed by the fall of the Glasgow City Bank in 1878, and by many other failures

of banks and bill-brokers, caused a serious shock to credit and business generally. Added to this the bad harvest of 1879, said to have been the worst of the century, was followed by a period of depression and stagnation in trade which was felt for several years.

With the depression of 1879 ended the periodicity of trade crises which was so marked during the century. Since then, crises have occurred in the years 1886, 1893, and 1908, but as these present no new features of importance it is not necessary to examine them in detail.

1914. The declaration of war in 1914 resulted in the greatest crisis the world has ever experienced. The position of London as the centre of international finance with its free market for gold, while greatly beneficial to our trade in times of peace, exposed us to grave financial danger in time of war. Bills drawn on London were everywhere acceptable, and consequently great numbers of them, representing a vast aggregate amount, were in circulation throughout the world. Fear and uneasiness impelled foreigners to convert their holdings into gold and to withdraw it to their own country. This caused great monetary stringency among the banks, accepting houses, and discount houses, which was intensified by the inability of the banks to get in the money lent "at call." On the other hand, the holders of bills drawn on enemy countries could not hope for payment in the near future. There was an immediate rush to sell credit instruments of all kinds and to call in loans, thus producing a demand for currency which was not available.

To prevent a "run" on the banks and the "dumping" of securities a bank and stock exchange "holiday" was declared for several days, while the bank rate was increased to 10 per cent to protect the reserves; the shortage of currency was met by the issue of Treasury notes; and the establishment of a three-months' moratorium relieved the immediate pressure on those who had to make payments. As a result of these measures, panic was allayed. The

advances to creditors made by the Government of up to 50 per cent of outstanding foreign debts and the loans made to stock-exchange operators and bill-brokers assisted materially in restoring conditions to a more normal state. It is a wonderful tribute to the stability of our financial system that it was able not only to withstand the terrific stress of this period but to bear the burden of financing the war years that followed.

The Post-war Crisis, 1920

The war had diverted industry from its normal peace-time channels into lines directly serving the needs of the great struggle in which we were engaged. On the declaration of peace, war-time industries found themselves burdened with a great surplus capacity for production; while industries restricted and neglected by war-time pressure had much leeway to make up to meet the shortage of stocks. Merchants who had found great difficulty in securing stocks during the war eagerly bought up the products available. Money was plentiful and credit conditions easy, so that a boom in trade rapidly developed. The declaration of high dividends and bonuses by firms which had flourished under war-time conditions induced heavy speculation on the stock exchange. The large amounts of Government, industrial, and other securities in the hands of the banks formed the basis for the creation of a mass of credit. The great increase in credit currency of all kinds forced up prices, necessitating increased supplies of currency. Increased prices led to increased wages, and a consequent increase in purchasing power. With a rising market, merchants bought largely, thus causing increased production which could only be effected at increased cost, owing to the shortage of raw materials. And so the circle went on until in March, 1920, wholesale prices stood at over 260 per cent above the prices of July, 1914.

A collapse was inevitable. Overstocked merchants and manufacturers anxious to unload, and the efforts of the

Government Disposals Board to get rid of vast stocks, caused prices to sag. Consumers held back from buying in expectation of lower prices, and the slackening of demand led to a further drop. Wholesale cancellation of orders followed. The banks restricted credit and called in their loans, while the declaration of the Government in favour of a policy of deflation compelled those carrying stocks on credit to unload. A slump ensued and prices fell rapidly until, by the end of 1921, wholesale prices stood at only 80 per cent above the pre-war level.

The post-war period shows in a concentrated form the features of every period of boom and subsequent collapse of trade. Every period of rising prices over a number of years develops a carelessness in incurring debts. At such times, the more trading done on credit, or, in other words, the more debt incurred, the more money is made—so long as the price movement continues upwards. Individuals, disregarding all sound rules of business, become rich. Credit is strained to the uttermost and margins reduced to a minimum, because as day after day passes this policy is found to pay. Why should a speculator carry 500 shares on an ample margin when on half the margin he can carry 1000 shares and double his profit? Men who have saved money on their salaries start new enterprises, dealing largely on credit, making rapid turnovers, and using their profits as a basis for further borrowing. Everyone is pyramiding, and the whole business situation is infested with marginal traders who exert a strong influence in raising prices but lack resources to withstand a downward movement. When the inevitable drop in prices takes place, their holdings are thrown on the market, intensifying the slump.

Each of the crises of the nineteenth century was preceded by a period when money was cheap and credit was easy. Borrowed capital was consequently used in extending legitimate industrial and commercial enterprises to a much greater extent than was safe; and to this must be added speculation in enterprises which could not be regarded as

legitimate commercial propositions. During these years of apparent prosperity, industries of all kinds were extending their rate of production. When the crisis arrived the panic in the money market was accompanied by a slump in prices, caused by manufacturers endeavouring to realize their stock to enable them to meet immediate and pressing demands.

PHASES OF THE TRADE CYCLE

Briefly stated the successive phases of the cycle are as follows—

Trade	Currency and Credit
1. A period of quiet and stable trade marked by considerable reorganization among industrial firms.	1. Money is plentiful, interest rates are low. Gilt-edged securities rise in price.
2. Increased activity in trade and growing confidence in business circles. New enterprises are undertaken.	2. Banks make large advances to industry by way of overdrafts or by discounting bills.
3. The upward movement continues. "Consumption" commodities (i.e. commodities of short life such as food, clothing, etc.) rise in price.	3. Speculative securities rise in price. Expansion of credit followed by expansion of currency. Interest rates tend to harden.
4. A general rise in prices follows the increase in credit currency. The gap between prices and cost of production is increased, i.e. profits rise. There is increased demand for commodities in anticipation of a further rise in prices. Capital commodities (i.e. commodities of long life such as real estates) rise in price. The interaction between trades makes the revival general. New plant and equipment installed.	4. Further expansion of credit and currency. Increased activity in circulation of cheques. Increased demand for advances from the banks.
5. Overtrading becomes general.	5. The increased demand results in money beginning to get scarce. The banks begin to watch closely the "liquidity" of the securities they hold against advances.

Trade	Currency and Credit
6. The high internal prices encourage imports and discourage exports. An adverse trade balance results.	6. Exchange rates move against us. Warned by this and by the dangerous position of over-trading firms, the banks increase interest rates and contract credit.
7 Firms trading on credit have to pay more for accommodation. They hasten to dispose of their stocks New enterprises checked	7. Liquidation of overdrafts. Gilt-edged securities fall.
8. Prices begin to fall Those holding goods bought at high prices endeavour to cut their losses by selling Orders for new goods are cancelled or cut down	8 Speculative securities fall in price
9. Prices fall rapidly. The gap between prices and costs becomes less Marginal traders are wiped out Commodities of long life fall in price.	9. Credit is further restricted. Business men do not avail themselves of those credit facilities which exist.
10 Production is reduced Unemployment increases. Trade is stagnant	10 Investment is stagnant. Interest rates fall.
11 Existing stocks are exhausted Retailers place new orders—small at first. Spirit of optimism increases	11 Credit begins to thaw by rigid economy and saving. Business men begin once again to borrow from the banks
12. The first stage of the cycle is reached again.	12. The first stage of the cycle is reached again.

Explanations of Trade Cycles

Seasonal fluctuations in a specific industry such as the coal industry are capable of a satisfactory explanation, as the causes are generally obvious. But with regard to widespread depressions affecting the whole field of industry periodically, the position is much more obscure. While some particular cause, such as the outbreak of war, or the failure of a large business concern, can usually be assigned as the direct cause precipitating a depression, these events cannot explain the regularity of their recurrence nor the

similarity of the features in successive cycles. Economists have long recognized that the peculiar features of the trade cycle must be attributable to some definite cause or series of causes. Since, however, "Crises and depressions have occurred almost contemporaneously in different countries, under every prevalent system of banking; in monarchies and republics; in countries having free trade alike with those maintaining revenue or protective tariffs; in those having only metallic money and in those having metallic and paper money; in such as have irredeemable paper money and in those having paper money redeemable in coin; in such as have gold as the standard alike with those having silver; also in those having gold and silver with a fixed ration between them,"[1] it is useless to consider any explanation which depends on one of these conditions or which is not equally applicable to any modern industrial community. Many theories have been advanced in explanation and the more important of these may be briefly examined.

Meteorological and Climatic Theories. The first and best known of these is the "Sun-spot Theory" of W. S. Jevons. Jevons, having examined in detail statistics relative to the prices of wheat in India, showed that these prices were subject to periodic variations. He estimated that the average period of trade crises was 10·4 years, and that since the period of development of the sun-spot cycle was also 10·4 years he endeavoured to show a connection between the two. He claimed that the periodic variations in the harvests of tropical countries were due to variations in solar activity. The emission of less heat, due to sun-spots, would adversely affect tropical harvests. A collapse of trade, in his opinion, was caused by the cessation of demand from India and China for British products, following the failure of harvests there due to the lesser solar radiation. While the theory of Jevons would account for

[1] Burton, *Crises and Periods of Industrial and Commercial Depression.*

the periodicity[1] of trade crises, it is not borne out by the fact that crises have occurred in England, Germany, and America at periods when the harvest in India was exceptionally good; and it does not account for such crises as that of Austria in 1882, the effects of which were felt all over the world.

Other economists since the time of Jevons have endeavoured to find a connection between climatic conditions and trade cycles, and have done much to illustrate the connection between weather, crops and industrial activity.[2] Raw materials play an important part in the trade and industry of the world. An over-abundant harvest on the one hand or a failure of the harvest on the other, due to changes in climatic conditions, not only affects the well-being of the agricultural countries concerned but, by altering the volume of their purchasing power, seriously affects the trade of other countries.[3] The fact remains, however, that the purchasing power of agricultural countries has come to depend not so much on the scarcity or abundance of the harvest as upon the prices which their products realize in the world market. A medium harvest or even a poor one may, through the higher prices realized, give the farming community a greater volume of purchasing power than a superabundant harvest sold at extremely low prices.

The Psychological Theory. The psychological factor, which was stressed by certain of the classical economists

[1] The disappearance of the periodicity of the trade cycles since 1879 does not necessarily upset Jevons's theory Our tropical trade does not now bear nearly so great a proportion to our total trade as it did during the eighteenth century, and the increased trade with temperate countries might counterbalance effects due to fluctuations of tropical harvests.

[2] Professor Poynting, in a series of Tables of the silk and cotton imports into Great Britain, and of the price of wheat, showed some remarkable coincidences in their periods of fluctuation, and believed that these periodic fluctuations probably pointed to a common meteorological cause.

[3] Sir William Beveridge has suggested that periodic changes of temperature may affect harvests and consequently the trade of all countries. He believes, however, that climatic conditions may be only one of several causes producing cyclical fluctuations.—"Weather and Harvest Cycles," *Economic Journal*, December, 1921.

as having a bearing on the development of the trade cycle, has been accepted by some modern writers as its main cause. The psychology of an individual displays a rhythmical character with alternations of periods of excitement and depression. The psychological theory attempts to apply this fact to the whole field of industry because trade goes through exactly the same phases as the individual, showing periods of excitement and periods of depression. When trade is good people are liable to over-confidence. Production is expanded beyond what a reasonable estimate of the demand would justify. The excess production causes a fall in prices, which creates a reaction in the minds of the business community. Want of confidence now underestimates business possibilities just as they had previously been over-estimated. "Mass psychology" is such that feelings of confidence or lack of confidence spread rapidly and the judgments of the individual are absorbed in those of the mob. Waves of optimism and pessimism therefore tend to alternate throughout the business world in periods corresponding to those of the trade cycle. Changes in the minds of business men, causing business judgments to swing "unduly towards optimism or towards pessimism,"[1] are regarded by some writers as one of the main causes of trade fluctuations.

As against this, however, it must be pointed out that there is the danger that this theory is, to some extent at least, confusing cause and effect. The "optimism" and "pessimism" are simply intelligent anticipations of future price movements, and under a system of stabilization their effects would disappear; moreover this theory fails to explain the periodicity of the trade cycle.

But while we cannot accept the psychological theory as a satisfactory explanation of the *cause* of trade cycles there can be no doubt that once the cycle is under way psychological forces do exert a powerful influence in accelerating the upward or downward movement. As trade improves,

[1] Pigou, *Industrial Fluctuations*, p. 51.

confidence begets confidence, resulting in further improvement; as trade declines we can see the effects of unreasoning crowd psychology which develops so easily in an atmosphere of uncertainty and apprehension.

The Under-consumption or Over-saving Theory. The supporters of this theory contend that the workers' share of the product of industry is too small. In a period of prosperity the surplus value created by the producers goes to the entrepreneur class, who invest it in fixed capital. Thus, the workers' income and the amount of purchasing power available is proportionately less than before. Consumption falls short of production; there is a scarcity of floating capital in industry; and a period of depression and stagnation follows. Mr. J. A. Hobson, the chief modern exponent of this theory, contends that the proportion of the national income saved and invested in "capital" goods normally tends to be excessive, thus reducing the amount available for the purchase of "consumers" goods. This "over saving" he attributes to the unequal distribution of income between the rich and the poor, the unspent incomes of the former resulting in an excessive accumulation of capital.

The objections to this theory may be briefly summarized—

1. It is generally true that the period preceding a crisis is marked by rising wages and increased employment. The power to purchase consumption goods is increased rather than diminished.

2. If under-consumption causes the depression then the price of consumer's goods would fall before the prices of raw materials and producer's goods generally. The reverse holds good.

3. The concentration of income in the producing class does not necessarily imply a smaller total consumption than if income were equally divided.

4. The theory fails to explain the periodicity of trade cycles.

The Competition Theory. We have already seen that the modern industrial system is very highly specialized and

that in spite of very many modifications it works broadly on a basis of free competition. Now, in a highly specialized industrial economy, goods must be produced in anticipation of demand and there is a wide time-gap between production and consumption.

Under a competitive system of independent producers, there is no co-ordination of production, and this condition is fostered by the secrecy with which business men shroud their production plans. It is contended that a period of good trade causes money to flow into productive enterprises, leads to an expansion of production, and attracts new producers into industry. The continued expansion of production eventually results in over-production, and while it has increased the cost of the factors of production general prices will fall. Industrial organizations with large fixed capital will continue producing for a time even at a loss. The fall in prices will force the less efficient producers to close down. Production will decrease and the contraction of credit will create a general depression. When the surplus production has had time to be absorbed, demand will revive and the cycle start on its upward movement again. It is undoubtedly true that our system of production leaves room for maladjustment between supply and demand, more particularly as the latter is by no means stable. It is not so much that the total demand for the products of industry varies greatly as that the distribution of consumers' demand between the products of different industries is liable to sudden change at the dictates of fashion or similar causes.

It is, therefore, more than probable that the individual producer will miscalculate in adjusting production to demand. This theory, however, goes beyond this and assumes that the miscalculations of all individual producers will tend at the same time towards over-production. Individual errors, on the contrary, would tend to cancel out, since while some would over-estimate the depth of the market others would under-estimate it. We cannot,

therefore, accept this theory as an explanation of the trade cycle. Unco-ordinated production is undoubtedly a factor in that cycle, but even if competition were abolished, as long as there is the time-gap between the initiation of production and consumption, it will still only be possible to *estimate* future demand.

It must be admitted, however, that there is in general a constant tendency towards expansion of output, and that certain factors exist which exert a steady pressure in this direction—

1. To obtain a return from the large capital outlay embodied in costly machinery and plant there must be a continuous flow of production.

2. This tends to stereotype production along certain lines which may not accord with alterations in demand.

3. The continual progress of invention and the improvements in the technique of industry are constantly increasing the volume of production obtainable per unit of effort.

4. The great economies which may be effected through the operation of increasing returns give a powerful impulse towards expansion.

These forces are in continuous operation. They are comparatively dormant during periods of depression, but they act with increasing force as trade improves and help the upward swing of the trade cycle.

Monetary Theories. It has already been pointed out that the ultimate end of production is the satisfaction of human wants as fully as possible. The distributive system is the means whereby the wealth produced reaches the ultimate consumers. The mechanism which keeps the productive and distributive organizations working is supplied by the system of finance and credit; and any failure in the operation of that system will throw the whole economic organization out of gear. In the short historical summary of the crises since 1815, given above, the reader must have observed the extraordinary dependence of the whole industrial

structure upon the organization of credit. In practically every case we have had an expansion of trade commencing with one industry and spreading rapidly to others. This resulted in increased profits and higher wages; and this again in surplus capital which was available for investment. The promotion of new enterprises, sound and unsound, followed as a natural sequence; and where the investors at first looked for a return in dividends, they soon sought riches by speculation.

Whatever may have been the cause of the original upward movement in trade, the conditions which create a boom and eventually culminate in a crash are almost entirely the result of monetary and financial causes. Blinded by over-confidence in a prosperous state of affairs, credit currency is manufactured, at first within reasonable limits, but afterwards to an extent which is an absolute danger to the State. This increase of currency produces a rise in prices, which in turn reacts upon the production of credit currency. If this is allowed to go on unchecked a collapse must inevitably take place. When the period of crisis is reached it is intensified by the restriction of credit currency which immediately takes place owing to the efforts of the banks to protect their reserves.

In the crises of the first half of the nineteenth century the expansion of credits was effected through the issue of notes by bankers to an amount far beyond what was justified by their reserves. When the Bank Act of 1844 restricted the issue of bank-notes other forms of credit were evolved in the forms of overdrafts and discounts which were not legally restricted. In the periods both prior to and after 1844 the ease with which credit was obtainable in prosperous times offered an incentive to speculation, thus forcing up prices to the point where collapse was inevitable.

From such considerations many economists have been led to the conclusion that trade cycles are due primarily to

defects in our monetary and banking organization.[1] According to economic theory our whole system of supply and demand normally tends towards equilibrium. When therefore we find periods during which this tendency does not operate, there must be some outside disturbing cause which upsets the balance. This cause, according to the monetary theorists, is the manufacture of credit under our currency system. By alterations in the rate of interest the banks cause expansion or contraction of credit and thus upset the normal relation between saving and spending.

Against this, two important arguments may be urged—

1. Crises have occured under varying conditions of banking and currency and the primary causes of the industrial fluctuations must lie in industrial conditions rather than in finance. The inflation of currency and credit make the boom period possible and determine its extent, but they do not cause it.

2. The trade cycle is not peculiar to one country but is world wide in character. Its causes, therefore, must be attributed to international rather than to *national* conditions, and so cannot arise from the operation of the monetary policy of a particular country.

Remedies Suggested to Lessen the Extent of Trade Fluctuations

Each of the theories examined approaches the problem from a different angle and each emphasizes a specific factor which influences trade fluctuations. Climatic variations affect the amount of agricultural production; psychological influences lead to over-confidence or an excess of caution; the gap between production and consumption leaves room for miscalculation; the industrial system tends towards excessive production; while the financial and credit organization aggravates the upward and downward

[1] Mr. Hawtrey considers that the trade cycle is essentially a monetary phenomenon which results from the contraction of "consumers' outlay" accompanied by decreased production.—*Quarterly Journal of Economics*, May, 1927, p 474

movements of trade. None of the theories examined satisfactorily explains the trade cycle, and it would seem as if a combination of causes rather than a single cause lies at the root of the movement. If, however, we cannot accept any of these theories as explaining definitely the trade cycle, and showing how it may be entirely eliminated, the theories DO point out ways in which some of the worst effects of the cycle may be lessened.

Whatever controversy there may be as to the desirability of perfect stability, it is generally agreed that in its result the trade cycle is injurious. The blessings of prosperity which appear in the upward phases are to some extent set off by the inequitable transfers of wealth which accompany them; they are far outweighed by the evil results of the downward phases and of the depression that follows. The total amount of wealth produced and employment afforded during the complete period of the trade cycle is less than if production and employment had been effected on a uniform level throughout the period.

Since the downward phases are a direct reaction from the upward phases, the extent and intensity of that reaction depend upon the strength of the upward movement. It may therefore be reasonably argued that remedies for the amelioration of the trade cycle should be directed first at reducing the violence of the upward swing.

Equation of Demand to Supply. One of the few advantages that can be claimed for large industrial monopolies is that they are in a position to check trade fluctuations. By their exact knowledge of market conditions and their control over production they can adjust supply to demand more accurately than can a host of competitive producers. It is in their interest to pursue this policy, since a steady supply at a remunerative price is more profitable to them than varying production at fluctuating prices. But the dangers inherent in this form of organization and the evils which accompany them are so great as to bar effectively any suggestion that monopolies should be encouraged on

these grounds. The development of rationalization should, however, tend towards the same end by making production more responsive to demand through the elimination of excessive or obsolete plant. The modern tendency towards understandings in various industries for the avoidance of cut-throat competition may also have some effect in stabilizing production. But the greatest factor in the attainment of this end is the dissemination of reliable statistical and other information which will aid producers in making estimates for future production. Something has already been done towards this end in the collection and publication of information vital to industry and trade. The United States are far ahead of other countries in this respect, and official statistical summaries and estimates are there available which enable the business man to form opinions as to the probable future course of economic conditions. In addition to the mass of statistical and other information available, the Harvard Economic Service and other similar undertakings provide their subscribers with valuable surveys of the existing economic situation. Charts and "Business Barometers" are also supplied, showing the trend and probable future movements of security prices, commodity prices, interest rates, etc., so that an attempt is being made to develop business forecasting into a science.

Business Forecasting

In this country we have the Cambridge Economic Service working along similar lines to that of Harvard, but in the amount of business statistics available we fall far behind the United States British statistics are, however, in general much more reliable than those of the United States, but against this there is the fact that the interval between their collection and publication is so great that in many cases they are out of date before their publication. Moreover, much valuable information embodied in Blue Books and Reports never comes under the notice of the ordinary business man.

Much valuable work can be done in the collection of vital information relevant to business conditions; and in its publication in such a way that business men can interpret it intelligently. Since it is essential that such information be impartial, its collection must devolve mainly on the Government, though considerable assistance could be given by the universities, Chambers of Commerce, and the great financial corporations. Until lately, owing to our dearth of statistical raw material, we had to make the best of the material available. Now, however, we have not only the London-Cambridge Index of the physical volume of production, but the Board of Trade Index, and a business index based on one of these would be of the greatest value.

Business is essentially a forecasting profession.[1] The individual business man may forecast badly or well, but he *must* forecast. He may detest statistics, but he cannot avoid using them. Since forecasting is unavoidable he should endeavour to use all the material available to make his forecasts as accurate as possible. He cannot expect to attain 100 per cent accuracy, but it is better to be 80 per cent accurate than 60 per cent The study of business forecasting is therefore one of great practical importance to the individual business man. Even in those industries which seem to depend most on technical efficiency or sound organization, occasions are bound to arise when success depends upon a correct judgment of the future. It may be a question of business expansion, of sales policy, or even of the time to purchase materials. Such decisions cannot be made as a mere matter of luck, but must be the result of

sound judgments, based not only on the attendant circumstances but on a full knowledge of general economic conditions.[1]

Two important results may be expected to attend a careful study of forecasting methods. Not only will a knowledge of economic causation and the normal sequence of economic events be acquired; but the business man will train himself to base his judgments on conditions "in the long run." Instead of forming judgments in the light of existing conditions alone, he will regard the present as the connecting link between the past and the future, and with a knowledge of the relevant facts be enabled to make better forecasts of future tendencies.

Not only is business forecasting and the supply of reliable statistical information on which it can be based a matter of primary importance to the individual business man, but it is a matter of vital interest to the whole community. If manufacturers, merchants, and traders are better informed as to world economic conditions, with special regard to the market tendencies of the products they handle, their reaction to that knowledge will inevitably lessen the violence of price fluctuations, give greater stability to trade and industry, and reduce the excessive volume of periodic unemployment.

Systematic Distribution of Public Work

The Central Government and Local Authorities who are entrusted with the expenditure of large amounts can assist materially in lessening the violence of trade fluctuations by planning ahead. Public constructional works, road-making, painting, etc., can be so distributed that the

[1] The rewards achieved by successful forecasting are not more striking than the penalties incurred from misjudgment In the slump which followed the boom of 1920 no industry suffered more severely than shipping. Yet months before the end of the war the Ministry of Shipping had collected information which pointed irresistibly to the conclusion that the world possessed shipping tonnage which would be greatly in excess of the post-war needs Those who took the long view and sold their ships made fortunes Those who saw only the boom and held on ended in bankruptcy.

volume of work done is small in prosperous times and large in times of depression. The aim is to expand the demand exerted by public bodies as general demand contracts, and vice versa so as to create greater stability in production and employment. It is, of course, obvious that this plan will benefit directly only particular industries and—since the work is not intended as a relief measure—particular classes of workers. But it may indirectly benefit industry and trade generally in times of depression. "One common feature of such times was stagnation continuing in face of a low bank rate private enterprise refusing to be roused by any amount of cheap money, dealers and manufacturers still paralyzed by fear of a further fall of prices, and of making losses in place of profits. In such circumstances, public enterprise, making for use rather than for sale at a profit and thus not cowed by the same fears, might lead to creation of credit that would not otherwise have come into being."[1] Railway companies, large public companies, and even private firms, could do much to assist this work by planning far ahead for capital expenditure, by pursuing a more stable policy, and in periods of depression by effecting improvements and extensions.

Control of Credit

It is generally admitted that whatever may be the primary causes of cyclical fluctuations, little can be done to check their operations so long as our banking system pursues the existing credit policy. Our banking system is always ready in prosperous times to increase the volume of money by means of credit advances, but when trade decreases it immediately reduces the supply of money by contracting credit. In this process of bringing about alternate expansions and contractions of credit the trading community itself plays an important part. In a period of rising prices the entrepreneur class is anxious to obtain as much credit-money as possible with the intention of repaying it when the

[1] Beveridge, *Unemployment*, p. 415.

purchasing power of money is less, that is to say at a lower real value. When prices are falling the reverse holds good and bank loans are repaid to avoid the payment of a higher real value through the increasing purchasing power of money; and the rate of repayment is accelerated by the pressure exerted by the banks. Thus, while rising prices prevail loans are made more rapidly than they are repaid; during a period of falling prices loans are repaid more rapidly than they are created. Since, as has been already observed, our economic system is a price system, the trading community rely on the barometer of prices as the main guide on which they base their trading activities. But by their own actions they upset the stability of that barometer by modifying the price level through changes in the volume of credit, and are consequently unable to read its warning of a gathering storm.

The remedy lies in checking the violence of the upward movement in prices by a restriction of credit. But the only effective means of restricting credit is to curtail the demand for it by increasing its cost. It has been suggested that this could be effected by an advance in the official discount rate of the Central Bank. It is not, however, quite so simple a matter as that would imply, and the extent to which that remedy would be effective is influenced by practical considerations. In the open money market credit is supplied, not by the Central Bank, but by the joint-stock banks. In Great Britain the bank rate is fixed by the Bank of England, and is the official minimum rate at which the Bank will discount first-class trade bills. The market rate, which is the rate charged for discounting bills in the open money market, is normally slightly lower than the bank rate. So long as the supply of money is plentiful, the competition among the discounters of bills will keep the market rate below the bank rate, which is thus rendered ineffective. When the Bank of England considers that for reasons of general policy it is desirable that the bank rate should be made effective, it is sometimes compelled to

borrow from the market funds—which it does not otherwise require—in order to reduce the market supply of money and so make it dearer. It can thus be seen that the Bank of England cannot act independently of general market conditions in fixing the bank rate. If for purposes of price stabilization the Bank should increase its rate the new rate would be ineffective so long as market conditions remained unaltered.

There is the further complication that all our chief British banks are profit-earning concerns whose capital is owned by private shareholders. So far as they are swayed by the motive of profits-making such concerns cannot be expected to turn down an opportunity of making a gain by the consideration that their action is opposed to the best interests of the community. Even regarded solely from this point of view it is by no means certain that it would be less profitable to restrict the manufacture of credit in times of boom. The amount of the loans made would certainly be reduced, but the net return from the smaller amount lent at a higher rate might well exceed the return from a larger amount at a low rate. At the same time, by increasing the rate of interest charged for loans during periods of boom, they would prevent over-confidence, and this would act as a deterrent to over-production and speculation. Much can be done to prevent trade fluctuations by the joint action of the banks. But to enable a price stabilization policy to be effected to counteract the movements of the trade cycle, our banking system must be built round a Central National Bank, which, unhampered by consideration of private interests, can pursue the policy best suited to the national interests. But since the trade cycle is international in character, and since finance is also now international, we have every reason to expect that with a better knowledge of the course of production a closer co-operation of the Central Banks of the world will tend to lessen the violence of future trade fluctuations.

CHAPTER VIII

UNEMPLOYMENT

UNEMPLOYMENT in its widest sense has existed from the earliest times. In primitive life man's economic activities were peculiarly subject to seasonal and climatic conditions, so that periods of enforced idleness were not uncommon. This is especially noticeable in the great primary industry, agriculture, where the intense activity of the spring and harvest periods alternates with the idleness of the winter season. Under the domestic system of production the workers took advantage of the periodic employment afforded by agriculture by combining with it domestic manufactures. Even here, however, shortage of raw materials or other cause resulted in periods when there was no employment for the worker.

In modern times the term "unemployment" is used in a much narrower and more technical sense. It would be better perhaps if we employed the term "industrial unemployment," as it is strictly in this sense that the word is now used. Not all the population of a country can actively be engaged in work, yet we do not class all those not so engaged as unemployed. We may distinguish—

(*a*) Those who live on inherited wealth and who do not need to earn a livelihood by their own efforts.

(*b*) Married women supported by their husbands.

(*c*) Vagrants and the "won't work" class.

None of these classes is included among those numbered as unemployed. A useful definition is that "Unemployment arises when the number of hours actually worked by the persons actually occupied in, or attached to, any given industry falls short of the number of hours' work these persons would have been willing to provide at the current rate of wages under the current conditions of employment,

it being assumed that the hours' work taken as a unit is of a given efficiency."

The value of this definition lies in the fact that it covers not only unemployment but short time as well. Since, however, it excludes unemployment due to personal inefficiency or general slackness, it leaves out all those individuals whom Sir William Beveridge designates as "half-employable,"[1] and who are normally included in unemployment returns. The definition is, however, sufficiently comprehensive for practical purposes, if we remember that it does not cover persons carrying on business on their own account, or workers out on strike.

Defective Organization of Employment

During the greater part of the nineteenth century it was the prevalent view that unemployment was due to defects in the individual character. With a fuller appreciation of the influence of cyclical fluctuations on employment it became apparent that the fault lay not with the individual but with the system. The demand for labour arises from the demand for commodities produced by labour in conjunction with land and capital. The demand for labour, however, can expand only within the limits fixed by the amounts of the other factors available. A shortage in the supply of labour tends to cause a rise in its price, and this is normally met by the development of labour-saving devices. A surplus of labour, on the other hand, tends to lower the price of labour and thus encourage employment, while the incentive to introduce labour-saving devices will be discouraged. Thus the supply of and demand for labour tend to adjust themselves within the limits set by the other factors of production. But given a sufficient supply of these other factors, there is no conceivable limit

[1] "A class of men getting work from time to time but normally leaving it after a shorter or longer period as a direct consequence of inefficiency, idleness, or the like. . . . They get turned off, not because the demand has changed, but because they do not satisfy the demand."—Beveridge, *Unemployment*, p. 135.

to the demand for the products of labour. Man's wants are infinite in variety, and it is difficult to conceive a condition where labour was idle because nothing more was required. An increase in population is accompanied by a more than proportionate increase in the demand for commodities; and this increase is accentuated as the standard of living improves. Theoretically, therefore, the demand for labour should be greater than the supply. Even taking into account the increased efficiency of production, the satisfaction of the needs of a rationally ordered community should absorb all the available labour.

That this is not so in the society of to-day is due largely to the maladjustment of the supply of and demand for labour, arising from the faulty organization of industry and trade and from the general failure of society to adapt our economic organization to changing conditions.

Unemployment is essentially a problem of industry, and its root causes lie in the defective organization of the employment of industrial labour. Industrial unemployment is one of the evils arising directly from the industrial revolution. The dissociation of capital from labour; the change from workshop to factory production; the development of large industrial centres of population; and the widening of markets were all factors tending to hinder and delay the adjustment of social conditions to the new and more complicated economic conditions.

Industrial and Personal Specialization

The organization of industry to supply national and world markets and the increased interval between production and consumption inevitably led to greater difficulties in adjusting supply to demand; and this in turn influenced the regularity of employment. But more than anything else the development of specialization led to maladjustment between the demand for and supply of labour and to consequent unemployment. This specialization affected labour in two ways.

1. Industrial Specialization. In the first place industry itself has become highly specialized. With the development of the world market, specialization, standardization, and large-scale production became increasingly important factors in the fierce competitive struggle for world trade. The increased complexity of industrial organization accompanied by an increased complexity in the organization of the distributive trades inevitably increased the difficulty of adjusting supply to demand. In some industries, such as agriculture, the difficulty lies in adjusting a fluctuating supply to a steady demand; in others, such as the iron-smelting industry, the problem is to adjust a steady supply to a fluctuating demand. We have already noted the effect of the trade cycle on production and consequently on employment in industry generally. In addition, any factor which adversely affects the normal demand for the products of a particular industry inevitably leads to increased unemployment in that industry.

2. Individual Specialization. The increased specialization of industry and its ever-increasing mechanization has made possible a more perfect division of labour. The task of the individual worker has become more and more limited in scope and his field of effort more restricted. The apprenticeship system has practically disappeared, and the skilled "tradesmen" have been largely replaced by semi-skilled machine-minders. This increases the dependency of the worker on a narrow branch of industry and increases his risk of unemployment.

Technological Unemployment

As a result of the application of technical improvements to industry in recent years there arises throughout the process of production a saving in the quantity of labour required per unit of output. The rationalization of the distributive services will also result in economizing labour, The net amount of labour required to place a unit of product in the hands of the consumer is therefore reduced or, in

other words, there is a decrease in employment per unit of product. Since the economic system does not adjust itself rapidly to changes, and since new industries do not arise quickly enough to absorb the displaced workers, what is known as technological unemployment results. Though the term has come into use only in recent years the problem is by no means new. The displacement of labour by new machinery, new methods, and new processes is a problem which has existed from the beginning of the industrial revolution. The rapid advances of science and the pressure of world competition in the post-war period has, however, speeded up the process to such an extent that the labour displaced by this cause has seriously swollen the abnormal volume of unemployment created by the world depression in trade. "I doubt if people realize how far this displacement has gone. In 1908, in a number of representative Birmingham businesses, labour represented 28 per cent and profits 12½ per cent of the sales figure. To-day these percentages are nearer 18 per cent and 6 per cent. I know of a trade in which in 1912 labour represented 10 per cent of the works cost, rose by 1930 to 20 per cent, and now on a modern layout will account for no more than 3 per cent." [1]

While technical improvements lead in many cases to unemployment, it must be remembered that this is not unemployment in the long run but in the short run. The whole history of industry has shown that technical improvements in an industry increase efficiency and lower the cost of production. The reduced selling price usually causes an increase in demand which brings with it additional employment, equal or in most cases greater than the loss sustained.[2] But supposing, as is probable, increased *general* technical efficiency causes a decreased employment per unit of product in all industries, what will the result be?

[1] Mr. A. Chamberlain, Chairman of Tubes, Ltd. Quotation from *The Times*, 15th December, 1932

[2] See diagram Fig 12, p. 241.

1. The world will be better equipped to supply our needs than ever before. Present lines of production can therefore be expanded to the extent that they will supply those needs.

2. Human wants are unlimited in number. Part of the displaced labour will be employed in producing to meet new wants. Many present-day "luxuries" will become necessaries and the general standard of living will be raised.

3. With increased efficiency the hours of labour will be reduced, thereby affording increased leisure with all it entails to the workers.

Industrial history has shown that these results have followed from technical improvements in the past; and we have no reason to suppose that similar results will not follow from future technical advances.

Restrictive Regulation. In considering the effect of specialization on unemployment we must note two other factors which operate in the same way. The first of these lies in the restrictive regulations of many trade unions. While it cannot be denied that the unions have served a useful purpose in the protection of the workers' interests, on the other hand, many of their regulations are ill-advised and injurious to the workers. Trade-union regulations may actually increase unemployment by—

(*a*) Resisting changes in "standard" rates of wages. According to the Ministry of Labour statistics during the period 1924–29 the rate of wages remained practically unaltered, ranging from 170 to 175 per cent of the pre-war level, while the cost of living was falling. From the beginning of 1924 to April, 1931, the cost of living index fell 18 per cent while real wages rose 20 per cent. Thus, by insisting on wage rates which industry cannot afford to pay, they destroy the elasticity with which "demand" for labour responds to "price."

(*b*) Insisting on "standard" rates of pay for sub-standard workers. Thus they make unemployment for such workers inevitable except in boom periods.

(*c*) Fixing lines of demarcation between employments. This adds to the cost of production in many trades and limits the fluidity of labour unnecessarily. In the light engineering industries, for example, semi-skilled workers could pass from one branch of trade to another, and in this way lessen the burden of unemployment.

Term of Employment. With the development of modern industry there came the need of making supply respond readily to demand. This involved the shortening of the term of the wage-contract, so that in most industries workers are employed on weekly contracts, and in some trades by the day or even by the hour. A slackening of demand or a change in conditions therefore leads to immediate discharge of workers and to unemployment.

Normal Unemployment

These causes are interwoven with our present system of industrial organization. In considering the problem of present-day unemployment in Great Britain, however, we must distinguish between those causes operating to produce the normal ebb and flow of the tide of unemployment and the abnormal causes resulting in the tidal wave of unemployment which has swept the country since the end of 1920.

In the decade before the war the annual averages of unemployment swung roughly between 2½ per cent and 7½ per cent. In providing an actuarial basis for the Unemployment Insurance Act of 1920 the Government actuary estimated the *average* rate of unemployment before the war at a little over 4½ per cent. The average since the end of 1920, when the extended Insurance Scheme came into operation, has been roughly 12 per cent. The difference between these rates "representing 900,000 persons in the insured trades is as good an indication as we can get of the magnitude of the specific post-war problem."[1]

The post-war unemployment figures therefore include an

[1] Clay, *The Post-War Unemployment Problem*, p. 47.

element of roughly $7\frac{1}{2}$ per cent of the total insured population which cannot be attributed to the causes producing normal or pre-war unemployment, and which must be explained on other grounds.

With regard to the causes producing what we may call normal unemployment both the Majority and Minority Reports of the Royal Commission on the Poor Laws appointed in 1905 considered these were: Cyclical trade; trends in industry; seasonal and casual labour resulting in under-employment; normal under-employment. We may consider each of these in turn.

Cyclical Fluctuations. This factor, which has already been discussed in Chapter VII, during the pre-war period had a greater effect on unemployment than any other cause. As we have seen, industry and trade are subject to more or less rhythmic fluctuations in which periods of good and bad trade alternate. Not only in particular industries, but in industry generally, there is a sufficient force available to supply the demands of industry in times of boom. When trade is normal or depressed there is therefore a considerable reserve of labour which industry cannot absorb.

"Broadly speaking, the industrial team of the country, not only in general, but also in particular trades, is numerous enough to carry on all old-established industries when times are good, and when conditions are only moderate or bad there is a varying amount of unemployment which, in the decade before the war, caused the annual averages of unemployment to swing between, say, $2\frac{1}{2}$ per cent and $7\frac{1}{2}$ per cent. The causes we have already mentioned are sufficient to explain the minimum of $2\frac{1}{2}$ per cent. The need of a reserve of labour to enable the country to expand its trade in good times means that even when conditions are normal this reserve will account for a further $2\frac{1}{2}$ per cent of unemployed." [1]

On the termination of the war it was obvious to any

[1] W. T. Layton and Others, *Is Unemployment Inevitable?*, p. 6.

thinking person that if material losses were to be made good lower wages, longer hours, and an increased rate of production were necessary. But trade-union policy resisted wage reductions, clamoured for a shorter working week, while the average production rate decreased. As a result there was an unprecedented rise in real wages in Great Britain, but since industry could not absorb workers at these rates there was also unprecedented unemployment. Assuming an over-high standard of remuneration to be rigidly fixed, then abnormal unemployment must result.

"If, and in so far as, unemployment is now resulting because, through fall in prices, real wages have risen and become rigid at a point above the productivity of the marginal labourer, the remedy must be sought in restoring the equilibrium thus disturbed. It cannot be found elsewhere." [1]

Seasonal Trends in Industry. Practically every industry in the country has seasonal fluctuations—periods during which business is brisk and periods when it is slack. The agricultural industry furnishes an extreme instance of such fluctuations, while the building trade is also peculiarly subject to seasonal and climatic changes. But these examples are by no means exceptional. Throughout the year there is no month in which some industry has not its slackest period, and, on the other hand, no month in which trade is not briskest in some industry. Thus, the peak month for employment at the docks is January; the clothing trades are busiest in May, June, and July; in July and August the railway and bus passenger service is busiest as are all "holiday" occupations, while the coal, gas, and electricity supply services are busiest in December. Each industry has its own characteristic periods of fluctuation, and it is a good thing for employment that these do not coincide. So far as unskilled workers are concerned some transfer is possible from slack to busy industries, but of course this cannot be done in the case of skilled workers.

[1] Beveridge, *Unemployment*, 1909 *and* 1930, p 415.

There is consequently throughout the year always some workers unemployed owing to seasonal slackness in their own industry.

Changes in Fashion or Industrial Technique. It is a characteristic of human progress that new wants tend to drive out and replace older wants. Changes in fashion affect the demand for particular commodities; one product is substituted for another; changes in technique involve the introduction of new machinery and processes; the transference of an industry from one area to another; the exhaustion of natural resources and similar changes all serve to break the continuity of production and produce unemployment, temporary or permanent.

Deficiencies in Industrial Training. The supply of unskilled labour is always in excess of the demand. The normal supply of unskilled labour is made up of those workers who by reason of their environment or the necessity of going to work at an early age have not received the necessary industrial training to fit them for skilled or semi-skilled work. This supply is constantly being augmented by numbers who by reason of inefficiency or other causes lose their place in the higher strata of employment. But a still greater influx comes from what are termed "blind-alley" occupations—those occupations which employ juvenile workers and throw them back on the market unskilled and untrained when they reach an age which demands adult wages. The Royal Commission on the Poor Laws, already referred to, considered that the existence of such a large proportion of casual labour was one of the worst causes of unemployment.

In addition to the causes of unemployment already considered, many other popular explanations have been advanced, two of which may be briefly considered.

1. Over-taxation. Great Britain, as a result of our services in the war, mainly on behalf of our Allies, bears a heavier burden of taxation than any other country in the world. It is argued that because of this we are handicapped as

compared with our foreign competitors. Thus, by increasing the costs of our goods, our export trade is reduced, production is curtailed, and unemployment created.

Direct taxation is, however, levied on profits, and therefore does not affect the cost of production. It may, however, affect industry—

(*a*) by reducing the amount of income that can be saved and reinvested as capital in industry, and

(*b*) by lessening the incentive it may serve to check initiative and enterprise.

On the other hand, local taxation in the form of rates does form a direct burden on industry. They are a charge upon industry rather than upon profits, as they must be paid even if there are no profits, or if a business is being carried on at a loss. Our increase in rates is due mainly to money spent on social services. Since these services benefit directly the wage-earning class, we may consider the excess of rates paid by industry as an indirect wage payment.

2. Overpopulation. It seems obvious that if a country is overpopulated there is bound to be unemployment. But if overpopulation is the chief cause of unemployment a difficulty arises when we try to decide what is the "optimum" population, and to fix the point beyond which overpopulation begins. Does it depend on the density per square mile? If so, Holland is more overpopulated than Great Britain—yet Holland has no serious unemployment problem. Or does it depend on the density per square mile in relation to natural resources? On this criterion the overpopulation of Holland would be even more marked. On either basis neither the United States nor Australia could be called overpopulated, yet severe unemployment has troubled both countries. Such terms as "overpopulation" are often used vaguely as if there were an absolute standard from which measurements could be taken, when in reality they are purely relative. We can only consider overpopulation in relation to a particular standard of living. An area inhabited by a British working population might

be considered "overpopulated," yet if inhabited by a population twice as large of the Chinese coolie class it might be deemed underpopulated. If the standard of living is fixed sufficiently high, or if the workers demand such a high remuneration for their services that a considerable proportion cannot find employment, then any country can be considered overpopulated.

Normal Under-employment

The causes already considered account for the main proportion of normal unemployment. But there is in addition the class already referred to which represents the "wastage" in industry—those workers who through personal deficiencies, whether of character, intelligence, physique, or old age, are only "half-employable" or are substantially unemployable. It has been estimated that including these "the minimum number of unemployed in insured trades will not, save in years of substantially good trade, fall below 400,000 or 500,000 men and women, unless ways are found of modifying the causes"[1] which produce this result. The individual units of this mass of unemployed are of course constantly changing, with the exception of the class of unemployables, but in average years the gross total remains roughly at about half a million.

The post-war economic conditions added a new element to our unemployment problem. Since 1920, though the real wages of employed workers have not only been maintained, but have risen considerably, Great Britain has suffered from abnormally large and continuous unemployment, heavy direct taxation, and a diminishing volume of exports. This change cannot be attributed to world causes, since it took place before the world slump in trade; though the causes have, of course, not necessarily been purely domestic. From 1920 to 1929 we suffered from severe depression in our basic industries accompanied by an

[1] Layton and Others, *Is Unemployment Inevitable?*, p. 7.

unemployment figure which seldom fell below 1,000,000. Of this number, some half million can be taken as representing the normal floating surplus. The remainder, like all abnormal rates of unemployment, is attributable primarily to maladjustments due to dislocations in the machinery of trade. We may note as causes of this dislocation the disturbance in economic conditions created by—

1. The excessive expansion of certain industries (e.g. the metal, engineering, and munitions industries) to meet a war demand, out of all proportion to the possible peace-time demand.

2. The interruption of our export trade during the war. This not only dislocated the foreign exchanges but also stimulated the development of foreign competitive industries to an extent which has permanently injured our export industries.

3. The discontinuance, up to the end of the post-war boom, of the normal adjustments of industry to the continuous technical and commercial changes which would have been made if there had been no war.

The readjustment required to adapt war-time industries to peace-time needs has been necessarily slow, and the problem of labour adjustment to peace-time conditions has been a prominent feature of the post-war period.

It must not be supposed that the abnormal post-war unemployment affected all industries equally. Over a proportion, estimated to lie between two-thirds and three-fourths of the insured population, employment between 1921 and 1930[1] has either been regular or subject to fluctuations comparable to those of the pre-war period. On the other hand, in certain of the basic industries unemployment has been heavy and continuous, in spite of a large reduction in the number of the insured population engaged. In the steel-smelting, rolling mills, shipbuilding, and general

[1] With the exception of the interruption caused by the coal strike in 1926.

engineering industries the unemployment figures were high. From 1925 the coal industry suffered severely, while cotton, wool, docks, and shipping all showed abnormal unemployment. In other words, the real post-war unemployment problem in this country lies in these basic industries on which the economic development of the country in the past mainly depended.[1]

This condition has been brought about mainly by changes in world economic conditions which have adversely affected Great Britain. British industry in the nineteenth century had been developed to supply the world with coal, textiles, iron and steel, and other manufactured goods. The new technique in the iron and steel industries has developed along lines unfavourable to Great Britain as compared with her foreign competitors.

"Since the war she has had to face the development of the cotton industry in the East; the substitution in a substantial degree of oil and hydro-electric power for coal; the generally less favourable terms on which the agricultural countries of the world have been able to sell their products, affecting not only the demand for our manufactures but also bringing a reduction in domestic agricultural prices; the disorganization of the trade with India and China and many other countries, resulting from political and other forms of disturbance, and to a large extent from the fall in the value of silver; the currency disorders in various European countries followed at a later date, in some cases, by stabilization of the currencies on a basis which gave a substantial temporary stimulus to their export trades; the growth of tariffs and alterations in tariff policies; and a great development of nationalism."[2]

It is obvious that such a combination of causes must affect seriously the trade of a country such as ours whose industry has been developed to supply the needs of foreign

[1] Royal Commission on Unemployment Insurance: Evidence, p 119.
[2] Report of Committee on Finance and Industry, p. 50.

markets. The industries dependent on the export trade must suffer, and unemployment in those industries inevitably follows.

Remedial Measures

When we come to consider remedial measures for unemployment it is important to remember that while many important measures have been designed for the *relief* of unemployment they do not in most cases do anything to effect a *cure* for the evil or to lessen its amount. Among the former we may notice—

1. **Relief Works.** With the object of providing work for the unemployed both the Central Government and the Local Authorities have carried out large schemes of development, such as the construction of arterial roads and docks, and the laying out of recreation grounds and parks. Since such schemes are intended for the relief of "general" unemployment the work provided must be such that the labour required is unskilled. In general, however, this method has proved ineffective and costly because—

(*a*) No standard of efficiency among the workers can be set up.

(*b*) Money paid to the workers cannot in most cases be regarded as wages earned, but simply as a disguised form of relief with a "labour test."

(*c*) Owing to the lack of efficiency of the labour employed, the completed undertaking costs much more than if carried out by contract.

(*d*) Many of these schemes have been hurriedly undertaken to provide relief work and are of little ultimate value to the community.

2. **Organized Short Time.** When, owing to a slackening of demand or for other reasons, it is necessary to curtail production the producer can follow one of three courses—

(*a*) Dismiss some of the workers and keep the remainder on full time;

(*b*) Retain the whole of his workers but employ them

in rotation, so that a worker is idle (say) every third or fourth week; or

(*c*) Retain the whole of his workers but work short time.

The first plan is usually preferred, where the work is unskilled, where there is opportunity for alternative employment, and where the supply of labour is such that there will be little difficulty in replacing the dismissed workers when conditions are favourable to increased production. The second plan is not regarded favourably by most employers because of the increased organization work required, but it is favoured by some because it entitles the workers to unemployment benefit for each week he is idle. Where the work is skilled, and particularly where the employer is desirous of retaining the services of efficient workers, the third plan is preferred. It involves less hardship to the workers and, moreover, it prevents that deterioration in both skill and character which takes place when workers are unemployed.

3. **Unemployment Insurance.** It is an economically sound proposition that workers ordinarily employed should have, when unemployed, some form of relief which will maintain them in a state of efficiency until a trade revival again affords them employment.

The National Unemployment Insurance Scheme of 1911 adopted the principle of ensuring to a workman, in virtue of contributions made by him and by his employer, the right to a definite weekly income for a limited period of unemployment. It was assumed that the scheme would be accompanied by an efficient organization of the labour market which would reduce industrial unemployment to a minimum; and that at the same time there would be a reform of the Poor Law which would give appropriate relief to those out of benefit. Neither of these essential conditions was, however, carried into effect, with the result that under the pressure of post-war conditions the scheme fundamentally changed in character. From a

scheme of industrial "insurance" it has passed into a system of general unemployment "relief," mainly financed by a tax on employment.

It was considered that the payment of insurance contributions would add to the self-respect of the worker and would give both him and his employer an interest in the solvency of the scheme. The system now in operation does neither of these. Rather to the contrary, one of the evil effects of the "dole" has been to sap the workers' feelings of independence and self-respect and to develop a work-shy class in the new generation.

It has been suggested by some authorities that the present scheme of unemployment insurance should be superseded by a scheme of insurance by industries. In favour of this proposal it is contended that—

(*a*) By placing the responsibility on each industry for its own unemployment, employers would be given a definite incentive to reduce the volume of unemployment. This would also form a valuable step towards the development of industrial self-government.

(*b*) Unemployment is part of social cost. It should therefore be included in the cost of production of each industry. Industries with high unemployment are now subsidized by other industries which have to bear part of the cost.

(*c*) It would be possible to make both benefits and contributions proportionate to earnings.

As against this, however, and in favour of "national" insurance it may be argued that—

(*a*) The essential principle of insurance lies in the pooling of good and bad risks and in the spreading of risks as widely as possible. From the insurance point of view, therefore, the principle of insurance by industry is unsound.

(*b*) A period of continued depression in a particular industry would throw a heavy burden on the industry if it could not look to more prosperous industries to share its burden.

(*c*) The incentive to employers to keep down unemployment would not be sufficient to induce serious effort.

(*d*) Cyclical fluctuations, which are one of the main causes of unemployment, are completely beyond the control of any individual industry.

(*e*) Insurance by industries would increase enormously the amount of administrative and clerical work, and, by making more difficult transference from one industry to another, would restrict the mobility of unskilled labour.

But whichever system be eventually adopted, if the National Scheme is to have any influence on the solution of the unemployment problem it must dissociate insurance from relief and revert to the principles of the 1911 scheme. This principle has been adopted and embodied in the Unemployment Insurance Act, 1934. The insurance scheme has undoubtedly been of the greatest benefit in alleviating the distress arising from the unprecedented volume of unemployment. But, on the other hand, assistance to the unemployed should not be allowed to become an obstacle to the prevention of unemployment. There can be little doubt, however, that National Insurance—or rather the new form of relief to the able-bodied which has developed from it—has resulted in making wages more rigid. In many industries, when the increase in unemployment indicated that wage costs were too high, the existence of the scheme stiffened trade-union resistance to demands for wage reductions. Thus, by making wage rates less responsive to trade conditions, the National Scheme has actually tended to prevent the reduction of unemployment.

Employment Exchanges

So far the schemes examined have been organized for the *relief* of unemployment rather than for its *prevention*. The employment exchanges[1] formed under the Act of 1909

[1] From 1909 to 1916 they were officially called Labour Exchanges. Report of the Committee of Inquiry into the Work of the Employment Exchange, p. 10.

might have developed into a powerful agency for lessening the amount of unemployment had they not suffered from neglect on the one hand, and, on the other, the imposition of a host of other duties, which have rendered their main purpose largely ineffective.

Originally formed for the purpose of placing men in employment, on the outbreak of war they became "an essential part of the machinery required for the mobilization of the natural resources for the purposes of war." With the restoration of peace their work was further increased. The duties imposed on them in connection with military and civil demobilization and unemployment insurance entailed so much energy that the main work of the exchanges was seriously affected. The attention of both the Government and the public has been so concentrated on the scheme of National Insurance that the exchanges have been overshadowed. Instead of energy being devoted to the development of the exchanges as an organization for the placing of workers and the decasualization of labour, they have been allowed to degenerate mainly into agencies for the payment of benefit.

The exchanges have done much useful work in placing men in employment; in the transference of workers in depressed areas to other districts; in the training of men in preparation for industrial employment in Great Britain or for agricultural employment overseas; and in their juvenile advisory work, aimed at preventing the misdirection of juvenile labour into blind-alley occupations or decaying industries. In spite of this, however, their work in the lessening of unemployment has fallen far short of what they might otherwise have achieved. They have not succeeded in abolishing the hawking of labour, and the only great achievement in decasualization has been in the case of dock labour. For this limitation of their success, there are two main reasons—

1. Their lack of compulsory powers. They could not compel employers to make use of their services in the employment of labour. Employers were conservative,

preferring the old methods, and only resorted to the exchange in cases of emergency, with unsatisfactory results.

2. They were overloaded with other duties which usually took precedence of the work of placing workers in employment.

"If the exchanges have not yet substituted an organized for an unorganized labour market, if their success has been least where it could have been most striking and is still most needed—in relation to casual labour—they have proved themselves, in peace as in war, an indispensable piece of national machinery." [1]

Unemployment is probably the greatest problem with which industry and the country at large is faced at the present time. The problem cannot be solved by the expenditure of public funds in the form of relief or of unemployment insurance. Efforts expended in this way are misdirected in that they are attempting to untangle the skein by beginning at the wrong end.

The solution of the problem of unemployment is both possible and practicable; though a satisfactory result will entail changes in industrial organization and methods. It is not possible within the scope of this book to do more than outline the steps by which the solution may be approached.

Organization of the Labour Market

The present methods of employment and recruitment of labour in many industries are wasteful in the extreme, and result in a much larger number of workers being attached to an industry than are required to supply the necessary labour. This inevitably means that in such industries some of the workers must always be unemployed. There is therefore an ever-growing need for a better organization of the labour market, whereby the mobility of labour may be increased and a better adjustment of supply and demand brought about. In the stress of world competition and

[1] Beveridge, *Unemployment*, 1909 *and* 1930, p. 323.

falling markets many of our industries have been considering and developing schemes of rationalization with the object of securing productive economies. Not one of these schemes seems to have considered seriously the necessity of applying the principles of rationalization to the employment of labour. Yet, without a complete organization of the labour market in all its aspects, unemployment must continue to rest as an intolerable burden on industry and the State. Though each industry to a great extent draws its supply of skilled labour from its own separate reservoir, there is nevertheless in the case of unskilled labour a considerable volume which may be regarded as common to several industries. It is necessary, therefore, that the organization of the labour market should be approached from the "national" rather than from the "industry" point of view: and as a preliminary it is desirable that the fullest possible information as to labour supplies should be available.

(*a*) *A Statistical Survey* of each industry is necessary in order to determine its normal labour requirements. Workers should as far as possible be scheduled to a particular industry; and where workers are common to two or more industries the numbers should be apportioned in proportion to the hours worked. When this has been done it will be possible to calculate the amount of the reserve of labour above normal requirements which is utilized by an industry under the present system.

(*b*) *Reserve of Labour.* It is in the interests of society that this reserve should be as low as possible, in order to keep down unemployment. The existence of this reserve in any industry is due to maladjustments in the organization of that industry. It is a duty which each industry owes society to keep this reserve as low as possible, and an industry should therefore be penalized in proportion to its failure to perform this duty. Sir William Beveridge has suggested[1] that the Minister of Labour should have power

[1] Beveridge, *Unemployment*, 1909 *and* 1930, p. 411.

to schedule any industry having excessive unemployment, and that such scheduling should have two consequences: first, that all engagements of workers should be made through an employment exchange, so as to bring the recruiting of the industry under supervision and limitation; second, that funds required to meet the excessive unemployment would be raised by a special levy on the industry through the employers. But since official machinery is notedly slow to move this implies that "excessive unemployment" would have existed for some time in an industry before any steps could be taken. We would, therefore, go further and suggest that each industry should be directly responsible for the maintenance of its own reserve. This would give the strongest incentive to an industry to keep its reserve at a minimum; and, further, it should help to place the burden of unemployment more directly on the shoulders of those responsible for creating it. "The principle of making industries provide for the exceptional unemployment created by their methods of engaging labour or involved in their conduct of business represents the barest justice to other industries, to the taxpayer, and, last but not least, to the individual workman for whom relief is the sorriest of substitutes for regular work."[1] An arrangement whereby each industry is made responsible for the maintenance of its own reserve of labour would require two safeguards—

1. That the industry must not be permitted to fix its labour requirements at a minimum in order to reduce its liability and then in busy seasons employ casual labour.

2. That the workers be prevented from using the limitation of numbers in the industry as a lever to force wages above the economic level.

(*c*) *Revision of the National Insurance Scheme.* It has already been pointed out that it is essential that unemployment insurance should be definitely a scheme of "insurance" and not tinged in any way with even the

[1] Beveridge, *Unemployment*, 1909 *and* 1930, p. 412.

shadow of relief. The suggestion that each industry should directly bear the cost of maintaining its own reserve does not affect the national character of the scheme. It would still be a scheme of "general" insurance, though providing that each industry should be liable for a certain fixed amount which it is within its own power to make as low as possible. The employers' contribution under the present scheme could go directly towards this purpose—the amount of the contribution in each industry being increased or diminished according to the "reserve of labour" in that industry. The contributions of the workers and of the Government would provide a fund which would bear the cost of unemployment in excess of the reserve.

(*d*) *Revision of the Poor Law.* A revision of the National Insurance Scheme on the lines suggested inevitably involves a reform of the Poor Law in relation to the able-bodied so as to provide some form of relief to those workers whose period of insurance benefit has come to an end. The Unemployment Assistance Board under the 1934 Act is entrusted with the care of all able-bodied unemployed whose right to benefit has expired.

(*e*) *Decasualization of Labour.* Any effective remedy for unemployment implies as an essential condition the decasualization of labour. This simply means that each group of similar employers which employs workers for irregular periods should take their workers from a central exchange. The exchange will concentrate the total employment of this group on the smallest number of workers which will suffice; and, as far as possible, will endeavour to provide full-time employment.

To the engaged workers under successive employers the advantages of such a system are obvious. "There can be no doubt that ultimately the organization of the labour market must be beneficial to the employer, in so far as it gives him better and more responsible service. Employing men casually, he gets men who have perhaps had nothing to do and little to eat for some days, and who, knowing

that their employment is casual, have little to gain by working hard or to lose by misbehaviour. Engaging men from an exchange he may, and as the system develops, will get for his casual work men who have only just left a job elsewhere, and who, depending for their regular livelihood upon the exchange, will have a motive to do well."[1]

On the side of the worker the change from casual labour involves risk of hardship to individuals. Instead of a large number of partly-employed workers we will have a smaller number of workers fully employed. The displaced workers will have to be provided for in some other way, and may thus suffer hardship. But apart from this, the gain is general. The retained workers benefit through the substitution of regular for casual earnings and by an improved standard of living; the community benefits indirectly in that it is relieved from the demoralizing effects of having large numbers always in a state of semi-starvation, and directly from the increased national dividend due to the increased efficiency of the workers; while this increase in efficiency and the improved quality of the workers is a direct gain to the employer.

Juvenile Labour

It is impossible to carry out a scheme of decasualization unless at the same time we dam the streams which are constantly adding to the reservoir of casual workers. A large proportion of unskilled and casual labourers is formed of those who entered "blind-alley" occupations as boys. The decay of the apprenticeship system has served not only to lessen industrial education but also to remove the employers' responsibilities. The great development of technical education offers a way out of this difficulty. On every employer of juvenile labour should be imposed the legal duty of providing an adequate industrial training for each young worker employed.

Vocational Guidance. The declining birth rate is resulting in a decrease of juveniles in proportion to the total population, and it seems probable that this decrease will become greater in the future. It is all the more important, therefore, that this shrinking supply of juvenile labour—on which the future labour supply of the country depends—should receive a good industrial training; and that every effort should be made to prevent it being diverted into wrong channels. The development of the work of vocational guidance for juveniles already carried on by Education Authorities and the exchanges is therefore a matter of the greatest practical importance; and in view of the falling birth rate and of changes in industrial structure, this work is likely to possess an increasing economic significance.

Trade-union Regulation

The development of any scheme for the prevention of unemployment must include either the abolition of the power of trade unions to legislate for industry or a more rational use of that power by the unions. Trade-union regulations and restrictions in many cases seriously hamper the development of industry and increase the cost of production. By their resistance to efforts to increase the rate of production of labour they have directly increased the cost of production, and indirectly decreased the National Dividend, and thereby prevented an improved standard of living. By their selfish policy of endeavouring to maintain wage rates above the economic level they have directly reduced the demand for labour, thereby throwing other workers out of employment. "Since with the present levels of industrial efficiency and wages severe unemployment cannot be avoided, the obligation on those who wish to maintain wages is clear. The higher standard of life of those who are in regular work is to some extent won at the cost of the unemployment of those who are not. The former and their leaders are in honour bound, not merely to remove restrictions on output, not simply to avoid

opposing improvements of industrial technique and organization, but to further such improvements in every way in their power." [1]

Displaced Workers

It is obvious that if the various industries reduce their reserve of labour—as they will naturally do if they are saddled with the cost of maintaining the reserve—each industry will afford steadier employment to the retained workers. This increased steadiness will, however, have been gained at the cost of displacing a larger or smaller body of workers. The process of decasualization, resulting in more constant employment for a smaller body of workers, and the process of rationalization, introducing more efficient processes of production, will each produce a similar result. What is to become of displaced workers? Some of them may be absorbed in the newer industries which are still undergoing expansion, while some may be absorbed in the development of entirely new industries. But new industries do not normally appear quickly enough to absorb even the workers discharged owing to the decay of the staple industries. It is impossible to conceive that the displaced workers should be suffered to remain unemployed, supported by national relief until such times as natural processes should wipe them out. It is equally impossible to imagine that trade recovery will be of such a sudden and sweeping character that the surplus labour will be automatically absorbed. Their absorption will naturally be a slow process, and until it can be effected the country must bear the cost of their maintenance. In the meantime there is already in existence machinery which can be utilized in the reduction of this surplus—

(*a*) *The Industrial Transfer Board* serves as a clearing house for information as to labour opportunities in different parts of the country, and assists unemployed workers to move to such places.

(*b*) *Industrial Training.* The training centres established by the Ministry of Labour, to which reference has already been made, can perform valuable service during the transitional period by training young unskilled workers for semi-skilled employment and by providing the necessary training to permit the transfer of workers from one industry to another.

(*c*) *Emigration.* The Empire Settlement Act of 1922 aims at furthering and assisting the settlement of British workers in our overseas Dominions If it is true that these islands are overpopulated then undoubtedly a wholesale scheme of emigration to the Dominions would be beneficial. But it is extremely doubtful, to say the least, that a reduced population in Great Britain would thus be enabled to enjoy a higher average standard of life with the same amount of effort. Whether this is so or not emigration must be regarded as a method of doubtful value for the reduction of unemployment. The type of worker required in the Dominions is just that type which has most likelihood of obtaining employment at home; while, on the other hand, those who cannot obtain employment at home are usually not fitted for colonial life. But there is in addition the serious practical difficulty that most of the Dominions have at present their own unemployment problems, and are not likely to welcome wholesale immigration until world conditions improve.

Taken at the very highest estimate the combined results of these schemes will absorb only a small proportion of our surplus labour. Some other means must be found of absorbing the remainder. Our industrial system in the past has been based on manufacturing for the export trade. A reduction of unemployment under these conditions depends mainly on an increased demand for British goods. This, of course, can only be obtained when our prices compare favourably with those of competing countries, and a reduction in British costs of production is essential to produce this result. But, apart from this, there can be no

doubt that the foreign markets on which the foundations of our great staple industries were built have seriously weakened. It is not that the world demand for manufactures is decreasing, for it is steadily increasing; it is, rather, that other countries are supplying an ever-increasing proportion of their own needs; while new industrial rivals have developed to compete with Great Britain for world trade. We must recognize that a proportion of our export trade has been definitely lost, and that efforts to regain this along the old lines are futile. The chief hope of salvation for British industry under the changed world conditions lies in a greater diversification of industry and in the development of new manufactures of high-class goods. In this way only, by developing along lines in which we have an advantage over other countries, can we hope to regain a definite leadership in industry and strike at the roots of the unemployment problem.

CHAPTER IX

LABOUR PROBLEMS

DURING the past few years public attention has been concentrated on our industrial system to a greater extent than in any other period of our history. The tremendous upheaval occasioned by the great world-war and the consequent breaking down of many cherished conventions, the sudden change from the comparative affluence of the war period to the poverty and unemployment brought about by the post-war slump in trade and the years of trade depression, and the constant friction between the employers and wage-earners in the industrial world have all assisted in bringing this about. In consequence, the industrial organization and structure, both in general and in detail, is subjected to considerable criticism. A very considerable proportion of this criticism is valueless and only serves to foster discontent; much of it deals with mere surface details, and only a small part goes to the root of affairs; the greater part of it is destructive, and very little indeed is constructive.

In social and industrial investigations, the psychological element is, to a great extent, of preponderating importance. The observation of facts which concern the observers is very much harder than any merely impersonal investigation. No matter how honest may be the intention, the whole upbringing, the mental training, the immediate social environment of the individual lend colour to his observations and bias to his inferences. This is one of the reasons why opposing and irreconcilable views of the same social phenomena are so often found; and it is one of the main obstacles in the way of reform.

INDUSTRIAL UNREST

Consider for a moment the conditions existent in the present-day industrial organization. Instead of easy and

smooth working there is constant friction. The recognition of the mutual interdependence of capital and labour should produce comradeship and unity of purpose. Instead there is mutual distrust and open and undisguised enmity. Highly efficient production should yield a large and steady output to increase the wealth of the community and add to the well-being of the people. There is instead a low output; and the flow of products, at even that low normal rate, is continuously interrupted by industrial disputes.

Industrial disputes have become a matter of such common occurrence that people in the course of time have come to regard them as more or less inevitable and natural. So long as that view is held it is to be expected that disputes will continue. A new viewpoint is required. People must be made to perceive the senseless absurdity of such disputes. They must visualize the untold misery and suffering, the almost incalculable economic loss, inflicted on the community by such disputes in the past. And, realizing these things, society will view the idea of a strike or a lock-out, not only with repugnance, but as something almost unthinkable and not to be tolerated.

Of course there are individuals who desire to perpetuate and even accentuate present conditions. There are, on the one hand, workers who believe that the only way in which any permanent improvement in their condition can be effected is to destroy the whole fabric of society as at present constituted, and by tearing away the very foundations of industry build up on its own ruins a new system. On the other hand, there are employers, actuated entirely by motives of selfishness and greed, who regard their workers merely as machines to be worked at the greatest speed obtainable, and to be scrapped as soon as their efficiency becomes impaired. Each of these groups is, of course, a minority in its own class, but each, in its own way, exercises a very considerable influence in fomenting industrial unrest.

At this stage of civilization it should be possible to

organize industry so as to obtain the maximum of production with the minimum of friction, and the maximum satisfaction of all those engaged in it. While it is agreed that this is an end ardently to be desired, there is disagreement as to the means necessary to achieve that end. There is considerable truth in the statement that the most unreasonable of all human fallacies is to expect men to act according to the dictates of reason. Conclusions are based, not on pure reason, but on reason biased unconsciously by sentiment, prejudice, self-interest, class-interest, or some other cause external to the facts. Views are to some extent distorted by environment; and it is this distortion, in the case of both the worker, and the employer, which is one of the chief barriers to industrial peace. And industrial peace can never be achieved till both sides, clearing away the fog in which they are labouring, discover and remove the origin of unrest.

TRADE DISPUTES

The growth of the feeling of unrest in the industrial organism during the last few decades is shown by the growth of workers' and employers' organizations, and the accompanying increase in the number and importance of industrial disputes. The table[1] on page 244 shows the number of trade disputes and their aggregate duration for the years 1919–33.

These figures are appalling. When they are considered in relation to the loss of wages, the loss in production in the industries directly concerned, the injury inflicted on other industries, and on the community in general, it almost seems as if there were a deliberate attempt on the part of the people to commit industrial and economic suicide.

The Government returns, from which these figures were taken, classify the causes of dispute, but this classification is apt to be misleading. Several causes may be in operation in a particular dispute, and, moreover, some important

disputes, and this cause was responsible for the majority of the disputes during the years mentioned. The present economic system has resulted in the production of wealth in such quantities that the general standard of life of all classes has been considerably improved. People enjoy better homes, better food and clothing, better education and recreation because more wealth has been produced and more is therefore available for distribution. The present-day worker is materially far better off than the workers of any other period; yet he is far less satisfied and contented. For, with this development, and the improved education of the working classes, the workers' wants have increased in a greater ratio than has the means of satisfying them. During the greater part of the war period, also, the workers enjoyed a standard of living far above that of any previous period. The drop in wages since 1919, while it still leaves certain classes of workers better off than in pre-war days, has exercised a considerable influence on industrial unrest. The increased comforts enjoyed had come to be regarded as a part of the normal consumption of the workers, and they feel aggrieved at having to renounce some of them. The worker does not compare his position with that of his ancestor; he compares it rather with that of the members of the contemporary employing class. While it is true that the worker now has a much higher standard of life than that of his ancestor, it is equally true that the difference in standard between employer and worker is much greater now than formerly.

But the worker's resentment is felt, not so much against the profits of the individual employer actively engaged in his own business, as against the dividends of the shareholders who take no active part in industry. Industrial evolution has widely separated the shareholder from the industry in which he invests. It has been contended that this is undesirable, but it is really a wide extension of the power of service and its exercise has vastly increased the scope of industry. Along with this separation there is, of course, a

less direct personal relation between the owners of capital and the workers; and this has helped to develop the idea that "the shareholder lives on labour and not by it." The idea of industrial function cannot, however, be confined to that of personal exertion, whether physical or mental. It must be admitted that investment is an industrial function and is entitled to remuneration as such. The root of the matter is the feeling that a considerable proportion of the product of industry goes to remunerate a function which involves little or no sacrifice or effort. This, however, involves the whole question of the distribution and accumulation of wealth which goes beyond the purely industrial field.

With a perfect labour market the relative attractiveness of the rate of remuneration on the one hand, and the relative difficulty of acquiring the qualifications required for a particular class of work on the other, would serve automatically to grade labour into different classes. In practice the most that can be achieved is to weigh the combination of skill and other qualities required roughly, so that each industry may pay a reasonably fair price for the class of labour it requires. Even in periods of good trade the labour market is very imperfect, in that supply and demand are only inadequately adjusted; in periods of depression the position becomes hopeless. "The conclusion . . . is nothing less than this, that the labour market has broken down. A market ought to secure a balance between supply and demand. In the labour market the response of both supply and demand to price is too slow and too indirect to give the requisite guidance. There is a price, that which we have called the economic rate of wages, at which there would be a balance. But the market has no constant tendency to gravitate towards that price, and no one knows how to ascertain what it is. It is not in the interests of labour *as a whole* to force wages up above the economic rate. On the other hand, the labour *in one industry* may force up wages and yet escape the penalties; it will gain at the expense of

labour in other industries. The problem is one of determining the relative rates of remuneration appropriate to different occupations, as well as a standard for labour as a whole. The free working of the market does not afford a solution, nor does the balance of power among trade unions and employers' associations. Incessant friction and ill-will are the natural results of the want of any guiding principle. No decision, whether reached by negotiation or by arbitration, possesses any moral force, for no one can ever give any good reason why the decision should not have been other than it was." [1]

Difficulty of Determining the Economic Rate of Wages

The difficulties of determining the economic rate of wages lie in the effects of the trade cycle and the instability of money values. If these could be eliminated, it is possible that data could be collected which would enable a rate to be calculated which would at least approximate to the true one. If the workers were convinced that such a rate were the highest that industry could pay without curtailing output or increasing unemployment, they would have no inducement to endeavour to obtain a higher rate by strike action with all the suffering entailed. To obtain the faith of the workers in the reliability of such a rate obviously requires that they should be satisfied, not only on the completeness of the data on which it is based and the correctness of the calculations, but also on the good faith of the employers.

The essential conditions required then are mutual confidence and knowledge. "Capital is ignorant of the necessities and just dues of labour, and labour is ignorant of the necessities and dangers of capital. That is the true origin of friction between them. More knowledge on the part of capital of the good qualities of those that serve it, and some knowledge upon the part of the men of the economic laws

[1] Hawtrey, *The Economic Problem*, p. 388.

which hold the capitalists in their relentless grip would obviate most of the difficulties which arise between these two forces which are indispensably necessary to each other."[1] While the intense individualistic spirit of business enterprise in the nineteenth century may have afforded a justification for the shroud of secrecy with which business men surrounded their affairs, the process of integration of industry is rapidly removing the necessity for such secrecy. Labour in general, except in so far as it objects to the whole capitalistic system, is satisfied that employers should receive a reasonable margin of profits; but, on the other hand, labour always is afraid of the exploitation of the worker in the interests of excessive profits. If the employers, in a spirit of co-operation, made it possible for the representatives of labour to inform themselves fully as to prices and costs of production, it would do much to clear the air for the amicable fixing of wage rates.

Hours and Conditions of Employment

The question of the remuneration of the worker is closely bound up with that of hours and working conditions. From practically the beginning of the nineteenth century the length of the working day has occasioned many bitter disputes. Though a ten-hours' day was first proposed by the Manchester magistrates in 1784, the great "Ten-hour Movement" really commenced in 1825 and lasted for thirty years. Since that time there has been a slow but steady decrease in the number of working hours per week throughout industry as a whole. It is, however, unfortunately true that this decrease is not uniform, and that there are trades in which excessive hours are still the rule. The distributive trades where, since profits are high, there should be no necessity to overwork employees, afford many instances of excessive hours. There is no legal limitation of the working hours for adults in shops; and in one of the largest multiple-shop concerns in this country the employees

[1] Carnegie, *The Empire of Business*, p. 87.

work a 54 hours' week. In spite of a century's legislation the hours of juveniles in textile factories are fixed at 57½ hours exclusive of meal-times, and 60 hours for other factories;[1] while in the unregulated juvenile occupations, such as errand boys, van boys, etc., fully one-half of those employed work hours ranging from 48 to 80 hours per week.

In all such cases there is general agreement that a reduction in hours is desirable; and in general there are sound reasons against a working week of more than 48 hours. It impairs the health and physique of the worker, gives no opportunity for leisure, and narrows his life and his outlook. A reasonable reduction in working hours has in many cases[2] been shown to result in increased production due to the improved health and efficiency of the workers. It is obvious that increased production cannot be indefinitely achieved by a continued reduction of working hours, but there is a strong presumption that increased output will be attained through a reduction of *excessive* working hours.

Given that the productivity of the worker remains unchanged, a shorter working week at the same piece-work or hourly rates could maintain output, without any increase in wages cost and at the same time give more employment. This would simply mean the spreading of work and wages over a larger number. The State and the Local authorities would gain through the reduction in employment insurance and poor-relief; but the purchasing power of the workers would be reduced by the amount of this gain; while the weekly earnings of the individual workers would also be decreased. To maintain the weekly rate of wages and at the same time reduce the working hours there must be an increase in the productivity of the workers, otherwise cost will increase. If productivity is not increased, and the working hours are reduced, then wages must fall. Increased

employment accompanied by a reduction in the wages of those employed simply means the transference of the burden of providing for unemployment from the ratepayers to the workers; increased costs, in a period of depression, and particularly in "distressed industries," will only result in further unemployment. It is only through the conjunction of increased productivity and a revival of trade that hours can be reduced and wage rates maintained or increased simultaneously.

When technical advances have resulted in the ability to produce the same quantity of goods as before at the expense of a greatly reduced number of labour hours,[1] it seems only reasonable that labour should share in the gains by a reduced working day. The labour policy of "ca' canny" has, however, operated against the attainment of this end. This policy is based on the "work-fund" fallacy, i.e. that the amount of work at any one time is limited, and that the more one worker does the less there will be available for others. Such a belief ignores the essential facts that the earnings of the individual worker are spent in purchasing the products of other workers; and that the production of each worker by increasing the national dividend increases the opportunities for additional employment. In the case of a sheltered industry where this policy is employed to raise the exchange value of labour as compared with other industries, the method is practicable, but unfair and selfish. In the case of industries working for the export trade, by increasing the cost of production relatively to that of foreign competitors it must result in depression and decreased employment. Applied throughout industry as a whole, it means that the total product available for distribution will be diminished and that wage-earners in general will suffer. Ignorance of such basic economic facts is responsible for much of the conflict between labour and capital. If it were clearly understood that the value of output is to a very large extent absorbed by wages, and that

[1] See page 216.

earnings are therefore dependent upon output there would be no desire to restrict production. Where a shorter working day leads to increased efficiency it may be in the employers' own interest to grant it. But naturally there is a limit, and once it has been passed the employer is unwilling to sacrifice part of his profits without a struggle.

The real basis in support of a demand for reduced hours lies in the fact that such a reduction is socially desirable. The standard of social life is changing, and these changes have important economic effects. There is an increasing production of secondary goods and services which seems likely to result in the creation of wider fields for employment and profit-earning in the future. To ensure the consumption of the products of these industries in such a degree as to create prosperous conditions in the industries requires increased leisure on the part of the workers. Reduced working hours are therefore economically necessary for the prosperity of an increasing proportion of industrial production. It is here that we see the importance of technological development. Technical advances have not created a *necessity* for reduced hours but they have made a reduction in working hours without a corresponding decrease in income *possible*. It should be noted, however, that while the general effect of technical improvements has been to lessen muscular strain on the workers, the introduction of mass-production methods, such as conveyer-belts, has in many cases made the work more intensive.

OVERTIME

Along with the length of the working day may be included the vexed question of overtime. For some industries, especially those of a seasonal nature, a certain amount of overtime is almost inevitable. In such cases, the employment of extra men would entail the installation of additional plant and machinery which would lie idle for a considerable part of the year, and this would not pay. But in other cases there is systematic overtime. Here the employer finds

it cheaper to work his men overtime and thus economize in overhead costs than to install additional plant. Such conditions, particularly when they are associated with unemployment in the industry, naturally tend to produce unrest among the workers. The workers consider, and rightly in some cases, that the abandonment of overtime would result in the employment of more workers; they regard it as an interference with the shorter working day, and in addition it tends to affect, adversely, their health.

Employment of Particular Classes or Persons

Questions involving the employment of particular classes or persons bring the personal element into prominence in industrial disputes; and show clearly the necessity of a knowledge of the principles of psychology in dealing with large numbers of workers. The demarcation of work, the substitution of unskilled, female, or juvenile workers for skilled men, dislike of foremen, the reinstatement of discharged workers, and similar causes are in some industries even more fruitful grounds of dispute than wages. When the dismissal of a collier's helper results in a strike of 20,000 miners, the want of clear reasoning and sound common sense is very apparent.

The friction between capital and labour developed in the early stages of the Industrial Revolution, and seems to have intensified rather than diminished with time. Capital and labour must work harmoniously for effective production; if they do not, both must suffer from the decrease in product that results. The development of the system of collective bargaining in the settlement of wage rates, while it has improved the position of the worker, has in some cases seemed to encourage rather than to prevent industrial conflicts and interrupted production, inflicting untold loss and suffering on the community.

While for each particular dispute between capital and labour definite causes are assigned, it is impossible to treat such disputes in isolation; they must be regarded rather

as separate manifestations of a deep-seated industrial unrest. Where formerly the aspirations and longings of labour were but vague and ill-defined, and the labour problem was simply one of wages and hours of work, now, behind the manifestations of labour unrest, lies the belief that the disabilities under which the worker lies are due to the capitalistic system of industry. This reaction against the existing system manifests itself in a demand for the control of industry. This demand is widely different from a demand for higher wages or shorter hours; it is essentially a demand to exercise directive powers in the conduct of industrial conditions and processes. This demand may be formulated as—

(*a*) **A Demand for Status.** The development of the method of collective bargaining and mass negotiation between the workers' unions and the employers' associations has helped to strengthen the recognition of the "dignity of labour." The development of large-scale production has, it is claimed, reduced the workers to the position of mere "hands"; skilled craftsmen are being replaced by semi-skilled machine-minders; individuality is destroyed, creative instincts suppressed, and the development of abilities hindered. It is claimed that the worker is in the best position to make suggestions as to the methods, processes, and conduct of the work on which they are engaged, since they are intensely interested in the technical efficiency of industry. The workers are therefore dissatisfied with the present system, and claim that in equity the control of industry should rest in those whose labour operates it rather than in the distant shareholders who have, in most cases, never seen the business. As to how this result may be attained opinions differ. While some would have the worker joined, as an active partner, with the capitalist in the control of industry, others aim at a complete reversal of the existing constitution of industry, under which labour, itself, governing the industry, will employ capital, paying it off at a fixed rate. In both cases, the aim

is to raise the status of the worker above the level of what is termed a "wage-slave."

(*b*) **A Demand for Security.** An uncertain level of income and the fear—or the actuality—of unemployment overshadows the lives of the workers. Above all else, therefore, the worker desires security; and this desire is the main moving force behind the demand for control. With the present organization of the labour market even a relative measure of security is unattainable, nor can it be attained without a radical alteration in the whole machinery of employment.

Unless the income of an industry is fixed and certain, it is not possible to guarantee fixed rates to both capital and labour. Any solution of the problem, therefore, implies that industrial risks must either be borne entirely by one side or shared between both. It would be, of course, quite possible to plan out the conditions of a partnership between capital and labour, under which they would completely share the control of an industry. This would involve the adoption of some method of equating a definite amount of labour[1] to a definite amount of invested capital, in order to get a basis for the distribution of the dividend. It would also involve the distribution of all risks over all the parties. There would be no guaranteed standard of remuneration, either to capital or labour; each would share, *pro rata*, in the surplus available for division. The fact that labour would receive advances in the form of current weekly wages, while capital received a yearly or half-yearly dividend, would not alter the basis of division so long as the totals received in each case corresponded to a general dividend.

Under such a scheme of full partnership, shareholders and employees alike would have a full voice in the policy and control of the industry. It is doubtful, however, if it would be acceptable to labour at the present time, for two

[1] The immense variety of labour would of course, involve difficulty, but that could be overcome by taking a particular grade of labour as a standard and measuring from it.

reasons. In the first place the province of labour is not adapted to the bearing of risks owing to its lack of a reserve. Secondly, the executive of the partnership, representing both shareholders and employees, would control, not only capital, but also labour. This would invade the existing sphere of the trade union, and in some degree place it under the control of the shareholders—a result which would not be acceptable to trade unions.

(*c*) **A Demand for the Public Ownership of Industry.** The demand for control is primarily concerned with the internal management and direction of production. But unless this control also covers the capital employed in industry, it will be ineffective, since the capital may be diverted or withdrawn. If control passes completely from the owners of capital, it is unlikely that supplies of capital will be available in sufficient quantity to meet the needs of industry. Hence the demand for control inevitably leads to a demand for the public ownership of industry. The worker has no antipathy to capital; on the contrary, no one has a greater respect for the efficiency of capital as a productive agent. His objection is against "Capitalism"—the private ownership of capital—a system which, he believes, deprives labour of part of its due proportion of reward. The feeling that there should be a more equitable division of the results of the joint efforts of capital and labour in production has had a powerful influence on the development of the demand for control and for the abolition of the present system.

THE CAPITALISTIC SYSTEM

The main features of the capitalistic structure of modern industry have already been considered.[1] Founded on the principles of personal liberty and personal initiative, capitalistic production has developed without co-ordination so that in effect there is no *system* of production and no central government of industry. "The normal economic system works itself. For its current operation it is under

[1] See Chapter V.

no central control, it needs no central survey. Over the whole range of human activity and human need, supply is adjusted to demand, and production to consumption, by a process that is automatic, elastic, and responsive. . . . This intricate system has been built and is maintained by the work of thousands of men, of keen but limited vision, each working within his own special sphere, each normally seeing and knowing only his own and the immediately adjacent territory."[1] But in spite of the apparent chaos, and the want of regulation and control of production, on the whole it works fairly well. "Even in bad times, the vast majority of the productive resources of society, both human and material, are being utilized, and the faith in which they have been launched into various channels of endeavour is found not to have been misplaced. And, on the whole, the wants of consumers, so far as these wants can be expressed in the offer of a money price, are punctually and fairly well supplied."[2]

One other important feature of the capitalistic control of industry must be mentioned. It is claimed in support of existing methods that since capital bears the risks of industry it is right that it should exercise the control. It is unnecessary to enumerate the risks to which industrial capital is subjected, but it is reasonable to assume that—

1. Better decisions will be made by those who will have to shoulder any resultant loss, and

2. The supply of capital for speculative enterprises will be greatly diminished if the owners have no voice in deciding how it is to be used.

As against this it may be pointed out that through the development of joint-stock enterprise the owners of capital no longer exercise direct control over industry. That, of course, is true, but the shareholders delegate their powers to directors who have themselves a strong financial interest in the welfare of the company. On the other hand, it is

[1] Salter, *Allied Shipping Control*, p. 16.
[2] Robertson, *The Control of Industry*, p. 86.

claimed that the owners of capital are not the only risk-bearers in industry. The workers invest their personal capital in the form of strength and skill in enterprises over which they have no control. In the event of an enterprise doing badly, the worker can transfer his investment to another field without loss—not so the employer. The trade cycle is the most important element in "normal" unemployment, and from its effects, employers and employed suffer alike. But since so little is known of their causes, the participation of the workers in the control of industry would be of little value in this respect.

No one would venture to assert that the existing economic system produces absolutely satisfactory results. Waste results from misdirected effort; real wants remain unsatisfied because they cannot voice an "effective" demand; costly luxuries exert a greater pull on production than cheap necessaries; and worst of all are the periodic breakdowns in the normal functioning of the economic machinery, producing trade depression, misery, and unemployment. But our system is by no means "static," and time may serve to remove these defects. But whether capitalistic control continues or is replaced by some other form, we may be sure that modifications will come as the result of a process of development rather than of violent change. Let us now examine briefly the principal proposals for changing or modifying the existing control of industry. Though such proposals are many and varied in form, they may be classified as—

1. Consumers' control,
2. Workers' control, and
3. Joint control.

Consumers' Control

The fundamental basis for the demand for consumers' control is that though the sole reason and end of all productive activities is the satisfaction of the wants of the consumer, yet in the pressure of competitive enterprise the

end is often sacrificed to the *means*. In other words, the interests of the consumers have in many cases been neglected and therefore require protection. The consumer's grievances have been tabulated as follows[1]—

1. That he will not always be able to buy what he is trying to buy.

2. That the prices of the goods which he buys are unnecessarily loaded with payments for the services of superfluous middlemen.

3. That the supply of certain goods which he buys is curtailed and their price raised by the monopolistic action of producers and dealers.

4. That self-interest is leading private capitalists to make reckless exploitation of certain natural resources to the great advantage of present but to the prejudice of future consumers.

5. Many of the real needs of consumers are left unsatisfied because they cannot be expressed in terms of a money offer.

Though these grievances are to some extent redressed by State action, yet dissatisfaction with the results are expressed in the schemes of (*a*) Consumer's Co-operation, (*b*) Collectivism, and (*c*) Communism, which aim at transferring the control of industry to the consuming public.

Consumers' Co-operation. It is not necessary here to deal with the organization and structure of co-operative associations. The fundamental idea is that consumers should voluntarily combine to acquire and manage a business in their own interests. In all countries where it has succeeded it has attempted further development through the process of integration. Local societies combine to form a central wholesale society owned and managed by themselves on lines similar to their own individual organization. The next stage is an effort to free themselves from dependence on capitalistic manufacture by the establishment, both by the wholesale and by branch societies,

[1] Robertson, *The Control of Industry*, pp 102–104.

of productive undertakings under paid managers. It is with this latter phase of their work that we are now chiefly concerned.

In the local societies through the local committee a fairly effective control is exercised by the consumers over the management. In the sphere of wholesale trade and of manufacture the power of control becomes decidedly weaker. In the case of the English wholesale society, the executive power is exercised by a full-time directorate, and is of a distinctly bureaucratic type; since the control exercised over it by the committees is necessarily slight, while that exercised by the individual member of a local society is infinitesimal. The management of the productive departments is capitalistic in character. The workers, whether in shop or in factory, are mere wage-earners, and have no share in the management; as a general rule they are ineligible for election to the management committees. It is possible to see here the clash between the two theories of industrial control; for while co-operation serves to link control with consumption it makes no attempt to bridge the gap that separates it from labour.

Collectivism. While co-operation represents consumers' control as exercised by a voluntary association, collectivism exercises control through compulsory associations—the State or the municipality. Under Collectivism, private enterprise is replaced by public ownership and management of industry, the expedients of price, marketing, and the ordinary mechanism of exchange being retained.

It is generally admitted that there are certain groups of undertakings in which public ownership is either essential or desirable, as, for example, the postal, telegraph, and telephone services. Most municipalities own and operate their own "public utility" services, such as the supply of gas, electricity, water, and urban transport; and there are indications of the future extension of this principle over a wide field. Many countries own and operate their own railway systems, but beyond this it is only in exceptional

instances that States engage directly in actual production or commerce.

The demand for the extension of the principle of nationalization usually is applied to those industries which tend to be subject to monopolistic control. Monopoly is a potential danger to the consumer, whose interests therefore require protection from the State. Such protection, however, does not necessarily involve either State ownership or operation of the industries concerned. The State can exercise its regulative powers to prevent monopoly or to ensure that the organization of an industry is framed in the best interests of the community; or it can accept the existence of a monopoly and control its powers by fixing "reasonable" or prohibiting "unreasonable" prices.

The objections to collectivism may be briefly summarized—

1. A public enterprise is usually handicapped in the matter of general supervision as opposed to management. Where the directing authority is a politically elected body it may suffer from the want not only of expert technical knowledge but of general business knowledge; in addition it is liable to be influenced by the effect of its actions on the body of electors. Where it is a government department its organization, procedure, and methods may be unsuited to the conduct of an industry, and may lessen its efficiency.

2. The separation of risk-bearing from control may, as in the case of the public joint-stock company, lead to—

(*a*) A greater extravagance in expenditure and less care in the avoidance of waste.

(*b*) The adoption of an over-cautious and unenterprising policy. This is more probable in the case of a public enterprise than in the case of a joint-stock company, since the liability of the latter is limited while in the case of the former it is unlimited.

3. Public enterprises may be maintained on an uneconomic basis.

4. Under a complete system of collectivism the State

must "assume the ultimate responsibility for regulating the flow of productive resources between different industries."

Communism. This system, like collectivism, involves the public ownership of productive enterprises, but it rejects the mechanism of price and exchange. In most civilized States a limited adoption of this principle is found expedient. Thus most States—

(*a*) Provide services for which the exaction of payment in accordance with the amount used by the individual would be impossible, e.g. the police, the army and navy, roads, etc.

(*b*) Provide services for which the people are either unwilling or unable to offer a price which measures their real need for such services, e.g. education, sanitation, etc.

In such cases the cost of these services must be borne by the community as a whole, and there is good ground for the adoption of the communistic principle. The wide extension of the principle, however, is a different matter and is fraught with grave dangers. The objections given above to collectivism all apply to communism. In addition there is the danger of the misapplication of the principle in the supply of services below cost without any real justification; the high level of taxation necessary discourages enterprise and accumulation; while a Communistic State must provide for the administration of industry without reference to the relation between price and cost.

Workers' Control

The dominant motive underlying the demand for workers' control of industry is the desire for "status." With the development of large-scale industry and its ever-increasing use of automatic and semi-automatic machinery, the skilled craftsman of former years has largely disappeared. His place has been taken by specialized semi-skilled workers and in some respects labour has come to be regarded as a less important factor in production than machinery. The worker naturally resents this attitude. He

has no desire to be regarded as a mere "hand," a cog in the industrial machine; but demands recognition as a human being with rights and responsibilities; with the rights of personal freedom and self-government; and with opportunities for self-expression. As a means of attaining these ends labour demands the exercise of self-government in the sphere of industry. This demand has found expression in many different forms, but the most important of these are (*a*) productive co-operation, (*b*) syndicalism, and (*c*) guild socialism.

PRODUCTIVE CO-OPERATION

The principle of productive co-operation is that the workers should supply the capital for the enterprise in which they are engaged, the employer is eliminated, and the work of organization is entrusted to elected representatives. In general, one of their members is elected manager or a paid manager is appointed; the workers receive standard rates of wages; and the profits are distributed on a wage basis.

Productive co-operation has not met with much success in the United Kingdom. At the beginning of this century there were about 125 productive societies, mostly in the boot and shoe, textile, and printing industries, but this number has now been reduced by over 40 per cent. In most cases these enterprises were initiated by the workers, but a few—together with many of the most successful continental organizations—have developed from private businesses, through the admission of the workers to a large share in the capital, profits, control, and management. Most of these societies have diverged, to a greater or less degree, from the basic principles of productive co-operation. In many, a considerable proportion of the capital is in the hands of outsiders, often Co-operative Distributive Societies. Many of the members are not workers in the business, just as many of the workers in the business are not members, but paid employees. In many cases the employees are

excluded from the management committee; and in only about one-third of the societies do the employees constitute a majority on the committee.

The path of productive co-operation is beset with difficulties. There is difficulty in obtaining capital and credit, more so than in the case of private or joint-stock enterprise; there is difficulty in finding markets, though that is to some extent met by sales to co-operative stores. But above all there is the difficulty of management. Success in modern industry depends more on wise and prudent leadership than upon loyal workmen. Where a fellow-worker is made manager it is not always the most capable who is selected. Where a paid official is appointed, the salary offered is not sufficient to attract a first-class man. In the former case the question of discipline becomes a problem; while in the latter the control of the committee generally fetters the initiative of the manager. As a result, the want of success of this movement has generally been due to failure on the side of management.

Syndicalism

The original idea of syndicalism, which developed in France, was that in each district the association of workers in each trade should take over control of the means of production. Over these associations the local Bourse du Travail[1] was to exercise a general control and adjust conflicting claims. Syndicalism claims the complete control of industry by the producers. This claim is based on the doctrine that, since all wealth is created by labour, the worker has "a right to the whole product of his work," and to control the conditions and circumstances of his labour. This end is to be attained by "direct action," such as a general strike, on the part of the workers. In its essence syndicalism is revolutionary trade unionism, and envisages the whole of industry being taken over, owned, and controlled by the trade union.

[1] Roughly corresponding to a Trades Council in England.

Guild Socialism

The position of guild socialism lies about midway between those of syndicalism and State socialism. Like the former, it would place the control of production in the hands of the producers representing each industry, but, like the latter, it would vest the ownership of the means of production in the State. Under this plan each industry would be constituted a public service owned by the State; through an elaborate system of committees a complete system of industrial self-government would be established; so that the industry would be managed and controlled by the workers engaged in it—brain-workers being included as well as manual workers. The following quotation gives a typical example of the suggested organization: "The guild socialism of the *New Age* is a proposal for the co-management of industry by the State and the trade unions. Ownership and control in the last resort are to rest with the community, but the unions are to be definitely recognized by the State as the normal controllers of industry. They are to be statutory bodies exercising a monopoly, but admitting of free entry on reasonable conditions. The amount and character of their production are to be determined for them by the State, but the methods and processes are to be left entirely in their own hands; they are to elect their own officials, and to be self-governing corporations with the widest powers. In fact they are to resemble in their main characteristics the self-governing professions, the doctors and the lawyers of the present. They are not to trade, but are to receive from the State a lump sum, calculated on the number of persons engaged in the industry, to be divided as they please. As they will include everyone concerned in the industry, from general manager to labourer, they will be in essence 'guilds,' i.e. associations not of *dependent* but of *independent* producers." [1]

It is claimed for this plan that it will, on the one hand, be

[1] Cole, *The World of Labour*, pp. 363–364.

free from the inefficiency which is generally associated with nationalized industries, and from the dangers of bureaucracy; and on the other hand, that it will safeguard adequately the interests of the consumers through State ownership. How far these claims are justified is a matter of opinion; but apart from the dangers arising from the monopolistic character of the guilds, there is the danger that the natural conservatism of such bodies would tend to check the rapid introduction of new processes and methods, and thus retard industrial development.

Joint Control

The preceding sections will have shown how radically the views of the employing class and of labour are opposed on the question of the control of industry. From the employers' side it is generally recognized that trade unionism must be accepted as a permanent factor in British industry. By some it is accepted as a necessary evil, but most employers recognize the advantage of having to contend with an intelligently organized force rather than having to deal with a disorganized and defiant mob. While it is generally admitted that trade unionism has had a strong influence in the moulding of character, and that its efforts have been instrumental in raising and maintaining the general standard of life of the workers, it is felt that its functions cannot usefully be extended beyond this. The historical connection between capital and control and between risk and responsibility seems a sufficient reason for regarding the labour claims for control as absurd and impossible. Many people even doubt that there is a genuine desire among workers to act on boards of directors and make decisions on policy, or that they are capable of so doing.

From the extreme workers' point of view labour must utilize to the full its present organization in a continued process of encroachment, meanwhile preparing itself by education and organization for the time when it will be in a position to take over the complete control of industry.

Until that time arrives, while it is necessary for the representatives of capital and labour to confer for the purpose of the settling of disputes, it must never be forgotten that they belong to rival camps. Offers of profit-sharing or similar schemes must be regarded as attempts to undermine the solidarity of labour and divert the labour movement from its ultimate goal.

These opposing views, if maintained, afford little hope of industry ever attaining that harmony of interest between capital and labour which is essential for its smooth working; and must eventually result in bitter class warfare. Organized labour in Great Britain possesses a strength which must be recognized as an industrial factor. That strength has been used in the past to acquire a considerable "negative" control in industry. But strength without responsibility is always a potential danger, since it may not always be used for reasonable ends; and if it must always be used as an "opposing" force in industry it may occasion untold damage. If labour can be vested with a measure of responsibility and associated with the management of industry, its powers will be exercised more carefully; much effort at present expended in resisting the decisions of employers will be saved, if labour has assisted in framing those decisions; labour's aspirations for status will to some extent be satisfied; while much constructive talent, at present wasted in the ranks of labour, will be utilized for the increased welfare of society. It seems reasonable therefore that, assuming the continuance of the capitalistic structure of industry, some method should be devised for associating labour in some degree with industrial management and control.

Joint Control in Individual Firms. 1. In England, in practically every case where some form of joint control has been established it has come through a scheme of labour co-partnership. Such schemes have arisen through the efforts of successful business men, who have given special encouragement to their workers to acquire a share in the ownership, and consequently in the control, of the

industry. The general principle adopted is that the workers receive in addition to their wages a share in the profits, the whole or part of which is allotted in the form of shares. The measure of control exercised by the workers varies enormously. In the one extreme, which differs little from ordinary profit-sharing, the workers have a representative on the board of directors whose chief function is to voice the grievances of the employees. At the other extreme the control of the workers is almost complete, differing only from productive co-operation in that capitalists who do not work in the factory are on the board of directors.[1]

Mainly as a result of the development of National Savings Certificates and other machinery for the encouragement of thrift, the amount of capital now in the hands of the working-class population reaches an amazing aggregate. The investment, over a period, of a comparatively small amount per head of the workers in the ordinary shares of an industrial firm, would place a controlling interest in the hands of the workers. In general, however, workers do not care to invest in the capital of the concern in which they are employed; and to be effective such a scheme would have to be the result of organized effort.

2. The principle that the workers *as such* should be entitled to nominate one or more representatives to the board of directors is practically unknown in England. There are numerous examples of this form of organization in America, while in Germany since 1922 the Works Councils are legally entitled to be represented by one or more members on the board of supervisors of joint-stock companies, such representatives having full voting powers. In neither America nor Germany, however, has this system met with

[1] As in the case of the Kettering boot manufacturers. Midway between these extremes may be instanced the South Metropolitan Gas Co., of London, where the employees own six per cent of the share capital, and have three representatives on the board of ten directors; while the joint committee administering the scheme also exercises a strong influence on the internal administration.

great success. The voting power of the labour representatives is insufficient to enable them to exert any effective influence on policy. They do, however, serve a useful purpose in that they are in a position to place the labour point of view on important questions before the board.

3. **Workers Committees.** In general the workers are more concerned with the problem of control as applied to the shop or factory than as applied to industry as a whole. From the practical point of view, therefore, the movement for the establishment of Works Committees is of primary importance. In Germany the Workers Councils established before the Revolution were legally established in 1920 as an integral part of the industrial organization, and are enjoined to assist the management with advice. In the United States, "the labour unrest which became acute in 1918 left a strange crop of industrial structures behind it," ranging from simple Works Councils to elaborate organizations based on the principle of the political constitution. In England the Whitley Report (1917) recommended the general establishment of Joint Works Committees representing employers and workers. The adoption of this recommendation has been rather disappointing, both in respect to the number of establishments concerned and in regard to results. During the period 1917–1922 there were over one thousand Works Committees in operation, but since then many of these have ceased to function. The constitution and function of these committees varies widely. Some are joint committees representing both employers and workers, while others consist of workers only with provision for ready access to the employers; some meet at regular intervals, while others are called together only when occasion requires.

With regard to the functions of Works Committees in general from the point of view of control, we may consider them firstly in regard to the nature of the control exercised, and secondly in regard to the scope of their activities. There are certain problems, such as those of general financial

or commercial policy, in which the control exercised by a Works Committee must necessarily be almost entirely "negative," though none the less valuable. American experience of such committees has invariably been that those set up for the enlightenment of the workers as to cost of production and amounts of profits for distribution have been the most useful and enduring. Where success has been achieved, it has come, not from any particular form of organization, but from the policy of taking the workers fully into the confidence of the employers.[1] In England the functions of Works Committees are almost entirely consultative, the executive power being vested in the management. But their work might be much more valuable if full information as to the position of the industry were available. Except in the case of concerns earning abnormal profits, and these are few, there is little to be gained by retaining the traditional secrecy as to financial matters; while, on the other hand, a fuller knowledge of the employers' difficulties and problems on the part of the worker leads to a smoother working of the industrial machine.

The problem of devolving the exercise of positive control on Works Committees is a more difficult one. The administration of schemes relating to welfare, bonus, and pensions, as well as matters relating to the healthful conditions of the workshop, furnishes obvious examples of subjects which could be dealt with admirably by a Works Committee. The question of discipline is a greater problem. While in American firms discipline, as a distasteful responsibility, is usually one of the first duties handed over to a Works Committee, in Europe generally it is the last. While successful experiments have been made in this country in entrusting disciplinary powers to Works Committees with

[1] The White Motor Co., of Cleveland, Ohio, furnishes an interesting illustration. Its policy is to take the employees fully into its confidence on every detail of financial management. It aims at fostering intelligent interest in the minds of the workers, but it gives them no power. It offers the entire work of its management to the criticism of the workers and is always ready to profit by that criticism.

regard to minor matters, such as time-keeping, etc., devolution in this direction has gone no further. The power of dismissal is still exercised by the management alone. Dismissals are mainly made on the grounds of (*a*) state of trade, (*b*) personal efficiency, (*c*) personal conduct, or (*d*) disciplinary reasons. German Works Councils are empowered to hear appeals[1] against dismissal for causes other than trade conditions and can award compensation, though they cannot enforce re-instatement. With a more prosperous condition of trade, it should be possible to experiment in the direction of establishing a joint control over dismissals for assigned causes. The control of a Works Committee over the appointment and conduct of foremen must, however, for obvious reasons, remain purely "negative." One British firm, at least, holds a preliminary discussion of such appointments by a committee of workers without executive powers, and the extension of this plan has obvious advantages. Finally, with regard to technique, it seems clear that this affords a wide field in which the workers can exercise valuable constructive functions in the government of industry. It is not fully recognized by employers that the worker can be intensely interested in the study of his own work; and can not only make valuable contributions to research but can make the results of that research more practically realizable. In their search for improved efficiency, employers are slow to realize that faulty organization may be the supreme factor in keeping down production and earnings. Valuable suggestions have been made by British Works Committees on improvements of technique and the organization of work, and it is to be hoped that a wide extension of co-operation along these lines may develop in the future.

NATIONAL JOINT CONTROL

In 1919 the German Government evolved a scheme of organization under which all industry would be centrally

[1] With final appeal to a District Committee.

directed and guided by an industrial structure which would give full representation to the interests of employers, workers, and consumers alike. The Works Councils formed the basis of the structure; at the apex was the State and Federal Economic Council; while between were the District Economic Councils, to which appeals from the Works Councils could be directed. On the national plane the Councils of the coal, potash, and electrical industries are practically the only remnants of this gigantic plan, with the exception of the Federal Economic Council. This Council, which is in effect an "economic parliament," is competent to deal with matters relating to every branch of finance, industry, and trade, and with the related social and labour problems. It consists of 320 paid members in eight groups, elected mainly by private associations representing the varied interests of the community. It has the right of initiating economic bills which must be introduced to the Reichstag; all bills involving economic or social policy must be submitted to the Council before being presented to the Reichstag; and before taking administrative action on economic matters the Government must consult a Committee of the Council.

The Whitley Scheme

In England the Whitley scheme provided for the establishment for each industry of a Joint Industrial Council composed of representatives of employers and employees in equal numbers. Since such Councils are voluntary and not compulsory bodies, the constitution[1] and methods of procedure are largely a matter for the industry concerned.

[1] The Interim Report of the Whitley Committee thus summarizes the matters it considers to be within the competency of a Joint Industrial Council—

1. The better utilization of the practical knowledge and experience of the workpeople.

2 Means of securing to the workpeople a greater share in, and responsibility for, the determination and observance of the conditions under which their work is carried on.

3. The settlement of the general principles governing the conditions of employment, including the methods of fixing, paying, and

In many cases the employers' and labour representatives meet separately, each under its own chairman, to discuss questions before they are presented to the Joint Council where a majority of each party is required for a decision. In 1932 there were fifty-one Joint Standing Industrial Councils under the Whitley scheme, and it is estimated that these organizations roughly covered three million workers. The industries concerned include wool, pottery, boots, printing, and the mercantile marine, while the railways and the Civil Service departments possess similar organizations.

On the whole, it must be admitted that the results of this movement have been somewhat disappointing. Though a number of valuable reports have been prepared, and such matters as education, organization, and industrial research have been discussed, while some of the Councils have recognized in full measure the burden of their responsibilities, many seem to have devoted practically all their attention to negotiations about wages and hours of work. These Councils have indeed brought employers and employed throughout whole industries together for common

readjusting wages, having regard to the need for securing to the workpeople a share in the increased prosperity of the industry.

4. The establishment of regular methods of negotiation for issues arising between employers and workpeople with a view both to the prevention of differences and to their better adjustment when they appear.

5. Means of securing to the workpeople the greatest possible security of earnings and employment without undue restriction upon change of occupation or employer.

6 Methods of fixing and adjusting earnings, piecework, prices, etc., and of dealing with the many difficulties which arise with regard to the method and amount of payment apart from the fixing of general standard rates which are already covered by paragraph 3.

7. Technical education and training

8. Industrial research and the full utilization of its results

9. The provision of facilities for the full consideration and utilization of inventions and improvements designed by the workpeople, and for the adequate safeguarding of the rights of the designers of such improvements.

10. Improvements of processes, machinery, and organization, and appropriate questions relating to management and the examination of industrial experiments, with special reference to co-operation in carrying new ideas into effect and full consideration of the workpeoples' point of view in relation to them.

11. Proposed legislation affecting the industry.

discussion; and have provided machinery for a continuous process of adjustment of matters in dispute; but they have led to little development in the joint control of industry. Their failure in this respect may be due in some measure to the long period of trade depression; and if this be so, a return to more prosperous conditions may lead to some development along this line.

Conclusions

"It seems certain that for many years to come private enterprise will remain the dominant form of industrial organization; but it seems also reasonable to hope, and to insist, that private enterprise should become less chaotic, less secretive, less tyrannical than in the past—more determined to achieve a real control over the blind forces that make for economic instability and dislocation, more ready to lay its financial cards upon the public table, more willing to respect and to use in the service of industry the self-governing instincts of the millions who carry out its commands. And by its side there is plenty of room for collectivism in selected cases, as well as for the Co-operative Society and the self-governing league of producing units on the Building Guild Model." [1]

From the point of view of the individual industry there is much to be gained by a better co-ordination of capital and labour in the control of industry; from the national standpoint the gains are even greater. It is only possible here to mention two of these by way of example. The rapid development of scientific and technical progress in recent years has vastly increased man's power in the production of wealth, and thereby benefited the community in general. At the same time the use of automatic and semi-automatic machinery by lessening the demand for manual skill has narrowed the gap between skilled and unskilled workers. Against this, however, the rapid technical advances by displacing many skilled workers have caused

[1] Robertson, *The Control of Industry*, p. 167.

what is now known as technological unemployment. This is a problem which can only be dealt with by a nationally organized industry, where the joint control of employer and workers can regulate the rate of change and provide for the absorption of displaced workers. The second example is that of the trade cycle. It has already been seen that employers and workers alike suffer from the downward phase of the cycle and the subsequent depression. In periods of boom it is to the benefit of an individual firm to increase its production to the uttermost, even though the resultant relative over-production is opposed not only to the interests of the industry in general but to those of the workers and of the community as a whole. In order to secure greater stability of trade and of employment, joint action of employers and workers on a national scale is eminently desirable. It has been suggested above[1] that by making each industry responsible for the maintenance of its own reserve of labour an incentive to minimize employment fluctuations would be provided. It should, in addition, be possible to devise means whereby restrictions could be imposed on excessive production during the boom period of the trade cycle and thus lessen the depth of the subsequent depression.

Though the interests of society require that capital and labour should work together smoothly and harmoniously in producing an ever-increasing volume of wealth, the present system is productive of constant friction, and tends to create an increasing clash of interests. As a result a steadily increasing amount of Government regulation has become necessary, thereby deepening the resentment of the business world against State interference. It was hoped, in view of the increasing congestion of Parliamentary business, that the Industrial Conference of 1919 would result in the establishment of a permanent authority which could consider industrial problems from the national standpoint. Though this hope has not yet been realized, it is

[1] See Chapter VIII.

none the less desirable that both individual industries, and industry as a whole should devise and establish a machinery capable of dealing satisfactorily with industrial problems.

The Settlement of Industrial Disputes

The many points at which the interests of the workers and the employers clash are constant sources of friction, and from time to time result in disputes which may culminate in a strike or lock-out. The strike or threat of a strike is the greatest weapon for effective bargaining power in the hands of organized labour. The right to sell, or to refuse to sell, one's goods or services at the price offered is inherent in the liberty of the individual. The right to strike is one which cannot lightly be taken away from labour and which will not be given up without a struggle. The worker has certain rights as a citizen; he has also certain responsibilities. A citizen who breaks a contract is held liable for damages; a strike or lock-out in breach of agreement should render the offenders equally liable. The danger of the strike as a weapon of industrial warfare is that its effects are not confined to the opposing interests or to particular classes. The employers suffer; the workers suffer, and even when victorious the gains achieved do not compensate for the sufferings entailed; the community suffers not only through inconvenience but through the loss of production during the stoppage. Various plans have been tried with a view to preventing this waste; and these methods of dealing with industrial disputes may be classified under five headings: (1) conciliation, (2) mediation, (3) arbitration, (4) judicial arbitration without power to enforce the award, and (5) judicial arbitration with power to enforce the award. Under the first heading employers and employees each appoint an equal number of representatives, who meet in a joint conference and try to settle the points of difference without outside intervention. When it does not seem likely that the end will be achieved, a mediator is called in who tries to find a basis of agreement

between the parties. Under the method of arbitration, the dispute is referred to some outside person or persons in whose impartiality and ability both sides have confidence and whose award they agree to accept. Sometimes a combination of these methods is used, as in cases where it is provided that if the conciliation board cannot reach an agreement the matter shall be left to arbitration. These methods are purely voluntary in character, and the decisions arrived at are not legally binding on either party.

The Canadian Industrial Disputes Act of 1907 gives a good example of the fourth class. Under this Act notice of the intention to strike or lock-out must be given, and the matter is then referred to the Industrial Court for investigation. During this investigation a strike or lock-out is prohibited. The decision of the Court is published, but it is not legally enforceable; reliance being placed on the power of public opinion to force the parties to accept the findings of the Court. Lastly, there is the method, adopted in New Zealand in 1894, and subsequently by the several States of Australia, under which strikes and lock-outs were prohibited;[1] and disputes are investigated by an official Court of Arbitration whose decisions are legally enforceable.

The general sentiment in the British Isles has always been opposed to the principle of compulsion: though compulsory arbitration was employed as an emergency measure during the war. Organized labour is strongly opposed to any measure of compulsion, and maintains vigorously its "right to strike." But, on the other hand, public opinion is changing on this matter. The serious industrial disputes of the past few years have made people ask whether it is right that any group of people should be endowed with the power to inflict injury and hardship on the nation at large. The belief has been steadily growing that the economic cost of strikes and lock-outs imposes a burden which the community should not be required to bear.

In spite of the fact that the British legislature has tried

[1] Strikes were once again legally permitted in Australia in 1918.

for over a century to find a satisfactory way of dealing with industrial disputes the ruptures have steadily become more serious. The Acts of 1824, 1867, and 1872 had very little effect. The Conciliation Act of 1896, which follows the Report of the Labour Commission in 1894, encouraged the formation of conciliation boards in the different industries, and empowered the Board of Trade to appoint conciliators or arbitrators on request. The Board of Trade did much useful work in the following years in the prevention of strikes and lock-outs; and the number of conciliation boards increased steadily. The year 1908 saw the appointment of a permanent Court of Arbitration, and in 1911 the Industrial Council was formed, consisting of representatives of employers and workers, to advise and assist the Board of Trade in matters relating to disputes. The Munitions of War Acts, 1915–1917, declared strikes illegal, and gave legal force to the decisions of the Arbitration Boards; but this Act was repealed in 1919.

The Whitley Committee had reported strongly against any system of compulsory arbitration, and its proposals were embodied in the Act of 1919. It established a Standing Industrial Court composed of representatives of employers and workers, with a number of independent persons all nominated by the Ministry of Labour. Any disputes may be referred to the Court with the consent of the parties concerned. The President in each case selects a panel from the members; and a chairman to act as umpire is appointed from the independent members. The Act also empowered the Ministry of Labour to investigate any dispute through a Court of Inquiry and to publish a Report. The publicity thus obtained has had a useful effect in bringing about settlements, a notable instance being that of the Dockers' Court of Inquiry in 1920.

In Italy industry is divided into seven groups or categories: agriculture, manufactures, trade, maritime and aerial transport, inland navigation, banking, and the liberal professions. The control of industry is exercised through

the "Syndicalist" organization which consists of thirteen national confederations—six representing the workers and six the employers in the first six groups given above; the thirteenth includes all engaged in the liberal professions and arts. Each confederation is composed of a number of federations which represent either workers or employers by categories, and these in turn are composed of syndicates representing still smaller categories.

It is the special purpose of these syndicates to deal with disputes between capital and labour. In each occupation the conditions of labour are settled by negotiation between the syndicates representing the two parties—local agreements being effected by the primary syndicates and national agreements by the confederation. In case agreement cannot be arrived at the issue is decided by an Industrial Court. Collective bargains, whether voluntary or imposed by the Industrial Court, must be approved by the Ministry of Corporations and published, when they become legally binding in that particular industry. Strikes and lock-outs are legally defined and both criminal penalties and civil damages are leviable in the event of either. To provide for this each syndicate is required to keep a reserve fund which is built up from levies on all whom the syndicate represents. We have here an example of collective bargaining enforceable at law which might with advantage be followed in this country.

The methods of settling industrial disputes have been dealt with briefly here because they are not the matter of primary importance. It is necessary to know not so much how to *settle* industrial disputes as how to *prevent* them. And so far as disputes result from a deep-rooted dissatisfaction with economic conditions, no method of settlement offers any hope of permanent industrial peace. What is really required is to remove the causes of unrest, and if this can be done industrial disputes will cease to occur. In treating a patient a doctor does not attack the symptoms from which he is suffering. He recognizes rather that these

symptoms spring from a diseased condition, and that when this is cured the symptoms will disappear. Industrial disputes are simply symptoms of economic disease, and there is little use in trying to alleviate symptoms while the cause is left untouched. But since the disease is of long standing it is probable that its eradication will likewise be a slow process.

In one sense there is a harmony of interest, not only between employers and workers, but among all classes of the community; while in another sense the interests of these classes are opposed. That industry and trade should attain and be maintained at the highest possible pitch of productivity is in the interest of all classes; but when it comes to a question of the division of the product, the interests of employers and employed, of manufacturers, middlemen, and retailers clash. In an industrial dispute there is a conflict, not only between the interests of the employers and the employed, but between these interests and those of the community in general. If often happens that while an industrial dispute serves best the interests of one of the parties primarily concerned, the interests of the community would be better served by peace. The extent of this conflict of interest governs the amount of the loss inflicted on the general public; and in the case of industries concerned with supplying the essentials of life this loss may be enormous. In the adjustment of this conflict of interests three factors must be considered: (*a*) the adjustment which will be most advantageous economically to the parties directly concerned; (*b*) that which will be most advantageous to the community at large; (*c*) that which will be most conducive to friendly relationship between employer and employees. Each of these should have its due weight, but unfortunately the personal interests involved in the first usually cause the others to be lost sight of. It is obvious that, if the interests of the community are left out of consideration, it will be much easier to reach a settlement. The economic cost of such a course would, in most cases, be too high;

consequently, most settlements reached will consist of a compromise based on a very rough estimate of the relative strengths of the factors involved.

It is not sufficiently recognized that the industrial system is still in a state of evolution. The "capitalist system" of production is a development of the last two centuries, and even in the present time changes resulting from concentration in capital and organization in labour have been seen. The development of the "capitalist system" has been productive of enormous benefits to the world at large. It has also, however, from the very nature of its development, caused many evils. But these are for the most part mere excrescences—unessential growths—and are not necessarily inherent in the system. Whatever else that system may be it is not *static*, and it cannot be assumed that its existing evils will be permanent. It is not through the overthrow of the present system of production, but in its fuller development, that remedies will be found.

One of the underlying causes of industrial unrest is the inequitable division of wealth. Wealth always has been and always will be unequally divided; and its equal division would not only be disappointing in its amount but would prove disastrous in its results. Those who voice this "inequitable division" do not seem to realize that there is a much more serious evil in the insufficiency of wealth. The stage has not yet been reached when production would suffice to secure everyone a reasonably high standard of living. The remedy here is obviously an increase in production. But to obtain greater production there must be greater efficiency; and to secure efficiency waste must be eliminated.

The failure of the worker to produce the amount of which he is capable is undoubtedly responsible for enormous wastage in production. The measure of a worker's capacity is that amount which he is regularly capable of producing over long periods without impairing his industrial efficiency. Measured by that standard, even under present conditions

of organization, there could be easily obtained a 30 per cent minimum increase in production without strain on the part of the worker. Add to this the increased efficiency resulting from improved methods of working and the gain is increased. Traditional methods of performing an operation are not necessarily the best, and in most industries there is much avoidable waste in the methods of working.

Waste, however, is not all on the side of the worker. There is much waste in productive energy arising from personal inefficiency and inattention to business organization on the part of the employers. With regard to this aspect Mr. Baldwin, in a speech at Welbeck Abbey, said: "Efficiency and management in this country, in most industries can be raised 10 per cent very easily and the effect of that on production would be enormous." This is a very conservative estimate. Faulty organization is a fruitful source of waste. To take one example from many: it is calculated that in the transmission of power by belting and shafting the loss of power developed by the engine averages from 35 to 45 per cent and much of this loss is preventable. Consider the waste arising from badly placed machinery, from antiquated plant, from the insufficient use of labour-saving machinery, from keeping skilled workmen doing unskilled work for a considerable proportion of their time, and from many similar causes in each industry. Think of the waste arising from competition between different firms; and of the loss arising from underpayment and unemployment which sap the efficiency of the workers. Add to all this the waste of industrial strife—the loss of production of 386 million working days during the last fifteen years—and it may be realized how far the present production of wealth falls short of what it might be. Under better conditions it is in all probability perfectly possible to increase the present production of industry as a whole by 50, 75, or even 100 per cent, and if even a small proportion of that increase is obtained prosperity will be advanced,

there will be an improvement in the standard of living, and the contentment of the worker will be increased.

There is a widespread desire that everyone should be able to live in a fair measure of comfort with a reasonable chance of proving themselves to the limit of their capabilities. To attain this there is required not the abolition of class distinctions but the abolition of class barriers. The distinctions are natural, the barriers are unnatural. The claim that all men have a right to an equal share in this world's goods is absurd and untrue. All men cannot even earn an equal share, because they are not of equal value to the community. But all men should have an equal right to a chance of getting their share. All have a right to pass the class barriers if they can prove themselves worthy of so doing.

There are many similar economic delusions which hinder progress and help to fill the measure of the workers' discontent. But they will never be banished by dependence on political or legislative action. They can only be destroyed by a widespread knowledge of economic principles and truth. It is especially difficult for people to take unbiassed views on economic questions which affect them personally. Our whole education system is wrong, in this respect, that it does not teach the mass of the people to *think*. As a result much real welfare has been lost through wrong or slipshod thinking. When employers and workers alike have learned to think for themselves, clearly and logically, they will be able to concentrate their attention on the essential conditions underlying industrial disputes, so that many, if not all, of the main causes of industrial unrest will be removed.

PART III

CHAPTER X

WORKS LOCATION, PLANNING, AND LAY-OUT

Production and Location

The problems of industrial administration arise from the purposes which an industry serves. In general, the purposes of an industry are the production of goods to satisfy a clear public demand. The profits of an industrial undertaking constitute the yard-stick by which the success of the industry in carrying out this service is measured; or profits may be described as that essential factor by reason of which the industry is enabled to survive. It has already been remarked that industrial enterprises tend towards larger units, as well as towards co-operative organizations and industrial combinations. In proportion to the scale on which an industry is carried on are the magnitude of the losses due to inefficiency and the importance of the factors influencing the costs of production.

Costs of production within the same industry differ in various ways corresponding to differences among the competing units in respect of every kind of industrial advantage —geographical location, lay-out of plant and premises, efficiency of equipment, organization, and human control. The essential function of an industrial unit is to offer the means whereby raw or semi-raw materials may be made into wanted commodities at a cost which will allow of a profitable sale.

In this "PRODUCTION" there are four fundamental elements, namely—

NATURE	CAPITAL	DIRECTION	LABOUR

which may be defined more specially as—

RAW MATERIAL	MACHINES	METHOD	MEN

In degree of importance, these elements are not necessarily equal, and the relative importance may vary with the country in which the industry is situated, with the type of industry concerned, and—for any given industry—with the nature of the processes used. Diagrammatically, the general process between raw materials and finished product may be said to follow the order shown on the left-hand side of the chart, Fig. 13. Production itself, as well as economy of production, is influenced by a great many considerations which bear directly and indirectly on the different stages of the work. The amount of care employed in balancing the conflicting requirements of all the factors will influence the margin between low or high costs of manufacture. The remainder of the diagram, Fig. 13, shows how most of these considerations may be reduced to a single factor, that of location.

Hence, the primary problem of industrial administration, when establishing any system of production, is to satisfy completely the factor of location. "A well-managed factory may fail in a poor location while a poorly-managed one often owes its very existence to the location."[1]

Whatever the significance of location may be in any individual case, the influence exerted by an industry's capital outlay and its extensive personnel is made almost irrevocable, when once determined, by the difficulty of moving.

The problem of satisfactory location may then be described as being governed by four major and three minor considerations, all of which bear directly upon economy of production—

1. Raw materials supply.
2. Transportation facilities.

[1] Professor Hugo Diemer, *Industrial Organization*, p. 67.

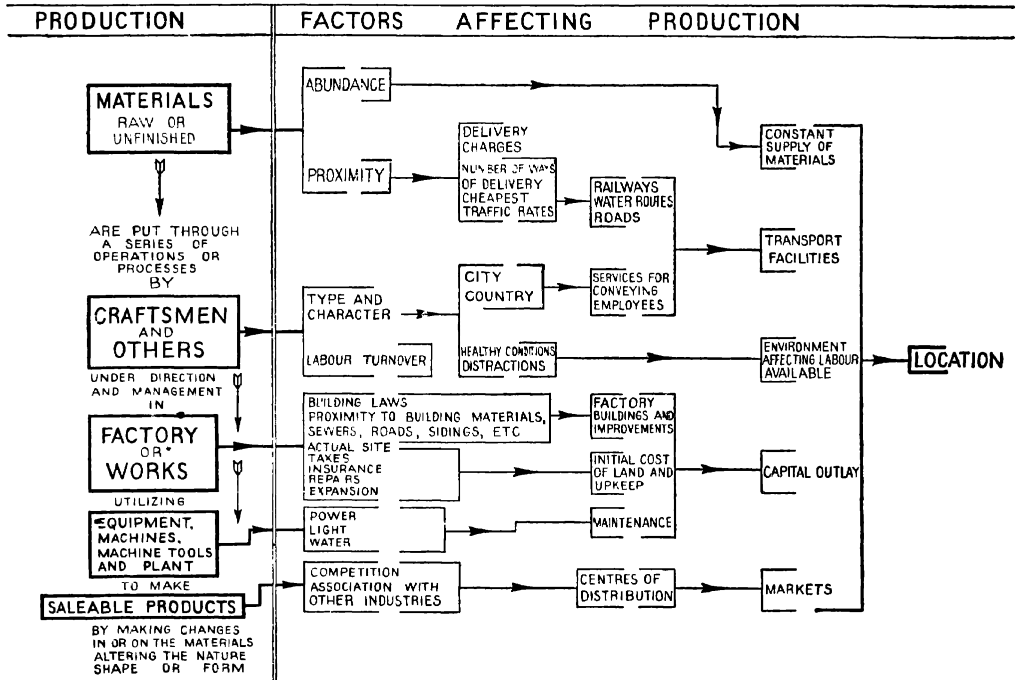

PRODUCTION
FACTORS AFFECTING PRODUCTION
MATERIALS RAW OR UNFINISHED
ARE PUT THROUGH A SERIES OF OPERATIONS OR PROCESSES BY
CRAFTSMEN AND OTHERS
UNDER DIRECTION AND MANAGEMENT IN
FACTORY OR WORKS
UTILIZING
EQUIPMENT, MACHINES, MACHINE TOOLS AND PLANT
TO MAKE
SALEABLE PRODUCTS
BY MAKING CHANGES IN OR ON THE MATERIALS ALTERING THE NATURE SHAPE OR FORM
ABUNDANCE
PROXIMITY
DELIVERY CHARGES
NUMBER OF WAYS OF DELIVERY CHEAPEST TRAFFIC RATES
RAILWAYS WATER ROUTES ROADS
CONSTANT SUPPLY OF MATERIALS
TRANSPORT FACILITIES
TYPE AND CHARACTER
LABOUR TURNOVER
CITY COUNTRY
SERVICES FOR CONVEYING EMPLOYEES
HEALTHY CONDITIONS DISTRACTIONS
ENVIRONMENT AFFECTING LABOUR AVAILABLE
LOCATION
BUILDING LAWS PROXIMITY TO BUILDING MATERIALS, SEWERS, ROADS, SIDINGS, ETC
FACTORY BUILDINGS AND IMPROVEMENTS
ACTUAL SITE TAXES INSURANCE REPAIRS EXPANSION
INITIAL COST OF LAND AND UPKEEP
CAPITAL OUTLAY
POWER LIGHT WATER
MAINTENANCE
COMPETITION ASSOCIATION WITH OTHER INDUSTRIES
CENTRES OF DISTRIBUTION
MARKETS

FIG. 13

3. Labour supply.
4. Markets.
5. Power supply.
6. Capital outlay for land, upkeep, and improvements.
7. Association with other industries.

These considerations cannot, however, be recounted in any definite order of priority. Their relative importance may be briefly discussed.

The present localization of industry, due chiefly to the result of early regional specialization, has been brought about by these factors, including in certain cases the factor of climatic conditions. It is a point of fact that the relative importance, although it varies considerably with the nature of the manufacture carried on, may in time have little bearing on the nature of the product; efficient organization and administration may keep an industry going long after the original reasons for its particular localization have disappeared.

Changes in the industrial structure, often non-specific and unpredictable, alter the convenience of particular localities. Advantages of certain localizations are often nullified, because other forces, arising later, favour a policy of decentralization for particular industries. The migration of industries northward in England, due to the development of coal and iron, is an established historical fact. The present trend of industry is a gradual transference to the south.

Economy of production is the primary standard of the suitability of any particular localization for an industrial works. The particular order of relative importance of those factors which influenced most the choice of an industrial site during the last century has given way to another order. The source of power available does not now exert the same influence as it did, owing to the enormous development in the distribution of electric power. The labour supply problem has been minimized, due to the increased mobility of labour whereby an industry may now draw its

workers from a much wider area. The decay of the apprenticeship system and the replacement of skilled men by machine operators have resulted in industry becoming less dependent on localized crafts. If a new plant is to be built one of the important factors will be the cost of the site. In the concentrated areas space is restricted and dear, and the tendency is to drive new enterprises into the country or "garden towns" where ground rents and local taxation are not so heavy. There is, *a propos* of this point, a statement of Mr. Ford's which may be quoted: "The belief that an industrial country has to concentrate its industries is not, in my opinion, well founded. That is only a stage of industrial development. . . . Industry will decentralize. . . . And, finally, the overhead expense of living or doing business in the great cities is becoming so large as to be unbearable." [1]

A secondary point which arises in any advantages to be gained in country sites lies in the not improbable prospect that the industrial undertaking may ultimately develop into a vast self-contained establishment. The workers in the country do not possess an "industrial sense," and are hence more manageable and less opposed to new technique; and being less obsessed by socially-inherited antipathy they will be more inclined to contribute their full efforts and co-operation.

The availability of a water front or the proximity to important railway lines and the main arterial roads of the country, the state of public utilities, the cost of extensions, and any advantages depending on the type of plant in view, must be thoroughly investigated before any question of location can be answered. The nature of the market to be supplied is an important factor in deciding between the relative merits of different locations. The smaller in scale an establishment will be, the more significant is the question of its position. Proximity to markets and centres of distribution is often more important than proximity to sources

[1] J. Lee, *Introduction to Industrial Administration*, p. 188.

of raw materials. Economical distribution of products is a factor which influences not only the location but also the capacity. That capacity, however, must be the embryo form of a capacity which may have to be increased by rapid expansion later on. Professor Edward Jones, in his *Administration of Industrial Enterprises*, sums up the problem by quoting the rule "that the best location for any economic unit is the one which yields the largest difference between capitalized gross income and total capitalized cost," and he comments on this by describing it as the "financier's way of saying that we should locate where the most valuable results can be achieved with the least outlay." [1]

In many cases the factor of transportation must be given priority over the others. Certain heavy industries may require reasonable proximity to both raw material sources and markets, since excessive transport costs on either one or the other could not be borne. In general, the location chosen should be determined, as far as it is affected by the factor of transportation, from the minimum mean costs of bringing the raw materials combined with delivering the finished products to the markets. For example, take the case of an establishment manufacturing paving brick. "It has been estimated that the relative weights of clay, finished product, and coal required in the industry are approximately as 40, 30, and 3 respectively. In a case of this sort it is evident that in choosing a site near coalfields, clay beds, or distributing centres, the most advantageous point would be next to the clay beds." [2]

Works Planning

Designing and planning the lay-out of an industrial works "is much like the planning of a farm, or a garden, or a residence, or even a kitchen—for a kitchen is a workshop.

[1] Professor E. Jones, *Administration of Industrial Enterprises*, p. 38.

[2] Professor Hugo Diemer, *Industrial Organization*, p. 67.

. . . In each of these cases there are certain functions to be provided with space requirements, which functions must sustain definite relations of area and direction with each other."[1] No definite principles, however, can be laid down on the question of plant and lay-out. It is governed, as in the problem of location, by economy of operation with easy and convenient arrangements. The plant and lay-out must be given the best possible environment and conditions in which to function. The design of the works in no small degree affects costs of production and influences the health and general welfare of the workers.

As the costs of production are influenced by the design of the plant and lay-out, so the design of the plant and lay-out are influenced by the character of the production. The works must be planned to ensure the continuous and also the "most economical manufacturing sequence of operations, and the most efficient production methods." The plan may be that required, theoretically, for a particular industry, but under actual working conditions the design may fail to achieve its purpose. Hence, experience in the size and arrangement of buildings and the suitability for the particular range of manufactures and output aimed at, as well as in the economy of internal transport and flow of production, counts for much in making out plans for any factory.

In any of the brief considerations of problems of works planning, lay-out, internal transport, environment, conditions, and so on, which appear in the following pages, the greater part of the material brought together will have a bearing on the engineering industry. In general, however, the same problems, though differing in detail, are applicable to any industry, and any brief analysis of them here may be said to apply to all industries.

The location and site of the works being decided on, the immediate and potential capacity of the firm's output may be fixed and the necessary equipment chosen. The planning

[1] Professor E. Jones, *Administration of Industrial Enterprises*, p. 57.

proper will then start, and thus the following main points arise—

1. The buildings (the exact type required and the nature of the most suitable materials).

2. The floor scheme (floor area, materials, and the lay-out).

3. Crane supports, shafting, and other necessary supports.

4. The power plant.

5. Administrative section—buildings.

6. Auxiliary services—provision for.

7. Factory and Workshop Acts, Insurance, local by-laws' requirements.

8. Electric mains.

9. Fire-prevention equipment.

10. Lighting—natural and artificial.

11. Water, steam, gas, compressed air, and other lines.

12. Heating.

13. Ventilation

14. Works lay-out.

15. Environment conditions.

16. Outside spaces.

17. Storage areas.

Buildings

For the design of an industrial plant an architect who is a specialist in industrial buildings, co-operating with the engineers, is essential. The general design must be compatible with the nature of the processes to be carried on, while at the same time the general conditions must have due regard to the safety, health, and welfare of the workers. There are three types of buildings from which a choice may be made according to the needs of the particular type of manufacturing plant—

1. Single story—with roof lighting usually of the saw-tooth type, facing north. The spans are built up to about

25 ft., the long slope of the tooth made of corrugated iron or asbestos slates.

2. Single story—with long span of roof trusses with provision for heavy lift travelling cranes.

3. Multi-story buildings. In general this type is advantageous where ground rents are high. The manufacture carried on must be comparatively light, as any heavy machinery can be installed only on the ground floor. The considerable reduction made in the cost of materials-handling equipment in the vertical plane has increased the scope of multi-story buildings. The least cost per square foot for floor space is found in three- or four-story buildings; after the fourth floor the cost per square foot of floor area increases rapidly. This is due to the necessity for providing columns or piers to support the different floor loads, and the additional cost for staircases, lifts, fire escapes, ventilation, and so on.

The next classification of buildings is under the materials used in construction. The more important classes are—

1. All wood.
2. Brick walls with heavy wood or steel framing.
3. Reinforced concrete or concrete blocks.
4. Steel frames with corrugated iron.

The comparative costs vary from the dearest, i.e. buildings with brick walls, encased structural steel framing and fireproof floors, to the cheapest—timber frame buildings (non-fireproof)—which are about 65 per cent of the cost of the former.

The principal considerations are strength, durability, safety, speed of erection, and cost. Careful selection is necessary to obtain those materials most suitable for the specific requirements of the processes.

In the case of engineering works with their attendant vibration of machinery the foundations must be carried down to firm ground. A great influence is exerted on the general design of the building by the Factory and Workshop Acts, fire insurance requirements, and by the laws of

of the associated dust and noise, will require a careful investigation of all possible sites.

Power

Certain industries are placed in circumstances that influence directly the solution of the problem of power generation. Iron and steel works, collieries, saw-mills and others, generate power by means of waste gas, waste heat, and timber and other combustible refuse. The main consideration for any works is to obtain its power in an adequate supply and in the most economical manner. The power used in the shops represents a small percentage of the total manufacturing costs of most products; nevertheless, the problem of the selection of the power system is one which calls for much discussion and investigation before decision. The choice depends ultimately upon the cost per horse-power year; sometimes this works out to be lowest when power is purchased from an outside supply.

The actual power required for the shops and for lighting may be small, but it is also a very small fraction of the total power, represented by the heating value of the fuel which has to be purchased. An inefficient generating plant is responsible for many unnecessary overhead costs, irrespective of the quantity or nature of the power demanded by the shops. For example, a steam reciprocating engine plant of good efficiency working from water-tube boilers would require about 2 lb. of coal per hour per horse-power, and would convert to power in the engine cylinder only about 9½ per cent of all the heat in the coal. That is, the indicated horse-power would represent 1273 B.T.U. of every pound of coal burned (assuming 1 lb. of coal of calorific value 13,500 B.T.U. to be used). The mechanical efficiency would not reach more than 94 per cent in an engine of good design and running condition, so that the horse-power available at the engine shop might be said to represent, in maximum value, 1197 B.T.U. for every pound of coal.

The next losses occur respectively in the generator, the transmission lines, transformers, and motors. These are represented as follows—

1. Generator with efficiency 96 per cent. Receives 1197 B.T.U. Delivers $1{\cdot}197 \times {\cdot}96 = 1149$ B.T.U. The loss is, therefore, $1197 - 1149 = 48$ B.T.U.

2. Assuming the line loss for average conditions to be 10 per cent, the current delivered to the transformers is represented by $1149 \times {\cdot}90 = 1034$ B.T.U. Loss $= 115$ B.T.U.

3. Transformer efficiency may be taken as 95 per cent. Therefore, the current available for shaft motors is represented by $1034 \times {\cdot}95 = 982$ B.T.U.

4. The motors will absorb about 10 per cent of what they receive, and the shafting or machines will have the equivalent in power of $982 \times {\cdot}90 = 884$ B.T.U. Hence a pound of coal of calorific value 13,500 B.T.U. is capable of contributing only 884 B.T.U., or $6\frac{1}{2}$ per cent of its cost, towards the actual work of production.

There are four main types of power-generating systems, namely—

1. Boilers, coal- or oil-fired, with turbine or reciprocating engines driving shafting directly, or generating electric power.

2. Internal combustion engines—oil, Diesel, semi-Diesel, or gas—used as in No. 1.

3. Purchased electrical power from a central generating station.

4. Hydro-electrical plant in suitable localities.

An adequate supply of power is understood to be sufficient power available at moments of peak loads, which may occur irregularly throughout a works. For example, a boiler shop contains many types of machines whose maximum load is very great and which comes on suddenly at irregular intervals, as in the case of shearing machines, punching machines, rolling mills, etc. In the actual work of shearing through a piece of heavy steel plate,

the machine will run light-loaded continuously, but an immense load comes on at the instant of cutting and lasts only for a second or two. This loading may be applied in greater or less variation of interval according to the operator.

At the present time in cases where an industrial establishment is actually being planned, the steam engine as a prime mover is not considered at all; its former preeminence having been completely eclipsed by the steam turbine, or the internal combustion engine. The use of oil as a fuel, either burned directly in an internal combustion engine or used to fire boilers, depends greatly upon its availability. If oil or gaseous fuel is readily available then the internal combustion engine competes strongly with any type of prime-mover. As regards burning oil for steam generation, the present state of development of less wasteful methods of using coal as a fuel has given a decided stimulus to the all-round adoption of coal in preference to oil. Examples of the modern methods of firing coal are found in the use of pulverized coal plants, or special automatic stokers, or the latest practice of high-pressure steam. Gas-engine plants may obtain the necessary gas from producer, blast furnace, or coke-oven gases. Hydroelectric plants are considered only when the localization of the works make such a development possible, and if the capital outlay necessary is not prohibitive in amount.

Whatever type of plant is most satisfactory its choice is the result of the careful determination of many factors. The cost of power, including fuel, storage, labour, renewals, maintenance, depreciation, and other items, must be thoroughly gone into. The chief object is to supply power or energy in the desired form, whenever required, at the minimum cost. On that point the issue may lie between generating it in the works plant or purchasing it from a central station.

In the future, the greatest hopes for economical costs per

horse-power year in industry lie in the development of wider distribution of electric power. Giant power is already overwhelming in its possibilities for the future of industry in many countries. Far-reaching plans have matured in the British Grid system, the Shannon scheme in Ireland, the Punjab scheme in India, and other schemes in Texas and Germany.

The main power supply having been settled, a suitable reserve plant in case of breakdown must not be overlooked. Transmission machinery must then be considered and compared. In most cases transmission of power by belt or rope drive to overhead shafting has been definitely superseded by electrical transmission; each machine tool or apparatus has its individual power leads, the electric motor now being incorporated in the particular machine or placed close by each tool unit. In the case of smaller machine tools which are placed close together and used intermittently, one motor may drive a small group of similar-sized units. The greater the subdivision of tool units and power equipment the more economical is the system.

Works Lay-out: Manufacturing Processes

There are two aspects of the problem of works lay-out, viz. whether the lay-out is for a new enterprise or whether, by means of modifications, improved efficiency is being sought in the existing lay-outs of established undertakings. The greatest number of present-day works "have grown from quite small beginnings, and in the course of their growth extensions and enlargements have been made," especially during periods when there was little time or opportunity to determine the most suitable alterations. Complete reconstruction often becomes necessary; sometimes the organization can be rearranged—by alterations of routes and by using a different transport system.

Manufacturing processes may be classified into three main divisions, according to the character, which may be of simple, analytic, or synthetic sequences.

A simple sequence, as is used in many industries, is diagrammatically illustrated as follows—

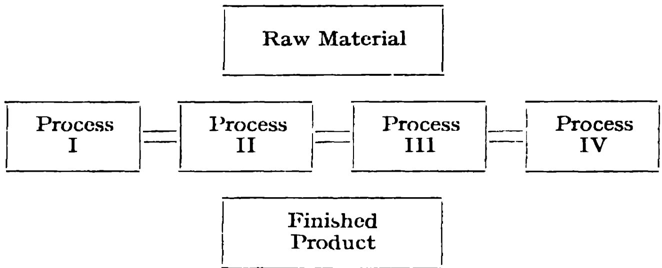


FIG. 14

Or the simple sequence may be arranged in parallel as shown on page 299, which is used when an industry produces different lines of products, each involving a separate chain of processes or operations.

The analytic sequence refers to the case when raw material of a complex kind is broken up and by means of various processes is made up into a large number of separate commercial products. (See Fig. 16.)

The synthetic or assembly sequence is necessary when a number of raw materials is used to make a variety of different parts which, individually, are produced through a number of simple sequences. Finally, after grouping into a number of minor assemblies, the complete yet complex product is turned out. (See Fig. 17.)

CO-ORDINATION IN PRODUCTION CENTRES

Simplicity should underlie all sequences in order to attain the maximum number of forward movements in a straight line. A point of importance in any order of manufacturing processes is the co-ordination of the capacities of each class of production centre within the series of connected departments. "It is necessary that each class of production centre should co-ordinate in capacity with those

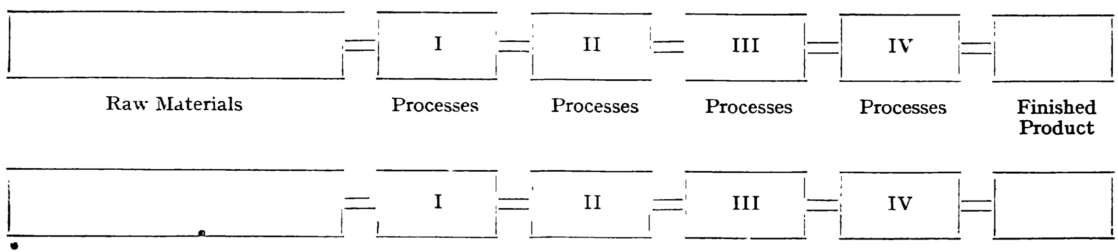

I
II
III
IV
Raw Materials
Processes
Processes
Processes
Processes
Finished Product
I
II
III
IV

FIG. 15

centres which precede it or follow it, and which must therefore either supply it with work or take work from it."[1]

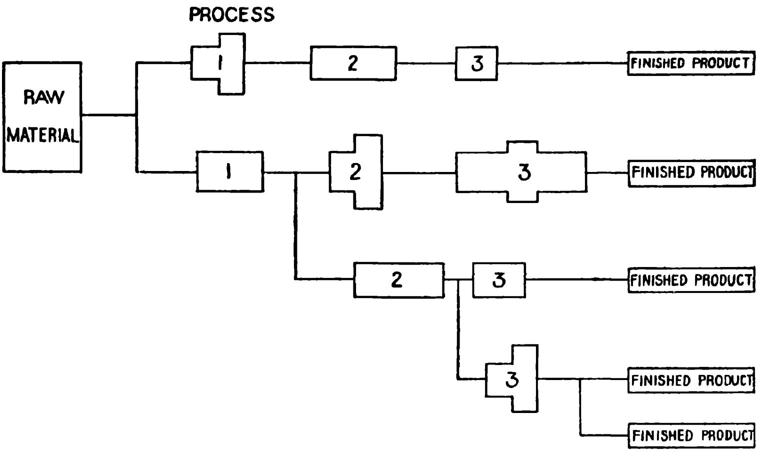


FIG. 16

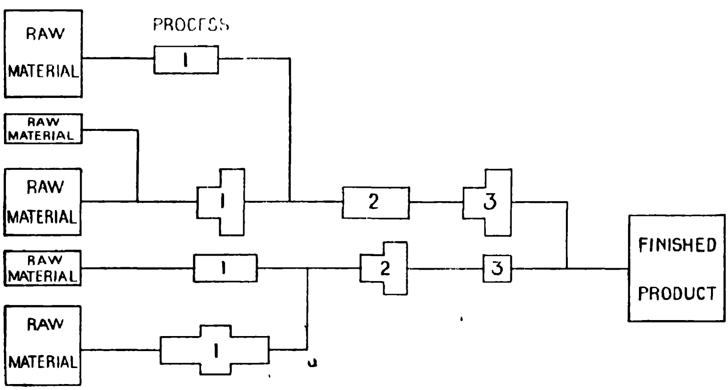


FIG. 17

For example, in the manufacture of a certain mechanism the sequence of operations for any one part might be: first starting from the moulding shop, to the cleaning and

[1] Professor E. Jones, *Administration of Industrial Enterprises*, p. 60.

fettling shop, to the plane milling machines, to the radial drilling machines, to special boring machines, to the multiple-spindle drilling machines, to the horizontal boring machines, and finally to hardened steel rollers. The actual moulding, since at the present time castings used in many modern productions are often made under a system of mass production, may be carried out by mechanical means. Thus, the amount of cleaning and fettling will not be large. The rate at which the finished castings leave the foundry cannot be greater than the rate at which each of the successive machine operations can be performed, else confusion will result. Similarly, if the rate falls off the shops will slow up. This point is obvious; but where the real necessity for co-ordination arises is between different intermediate processes. In a modern works where line production and the direct feed type of lay-out is adopted, each particular part is finished in that part of the works which is as close as possible to the spot where it is required to take its place in the assembling of the finished product. There must, under such a system, be no possibility of a shortage—or of a defective part—since the holding up of even one part, or the discovery of any inaccuracies in the manufacture of one part, will stop the production of the whole works. Hence, if the capacities of the various machines mentioned above are considered for the manufacture of the particular part, the following arrangement may result—

Let the different processes be identified as A, B, C, D, E, F, for the milling machines, radial drilling machines, boring machines, multiple-spindle drilling machine, horizontal boring machines, and rollers respectively. The correlation is based on the multiple-spindle machine having a capacity of 200 units per unit time.

One machine in section D will keep fully employed four machines in section C and two machines in section B of respectively 50 and 100 units capacity per unit time. If the machine in section D was replaced by a slightly larger

one, say, of 210 capacity, and the remaining sections were adjusted in the best adjustment possible

Section A would run at a loss of 30 units
Section B would run at a loss of 90 units

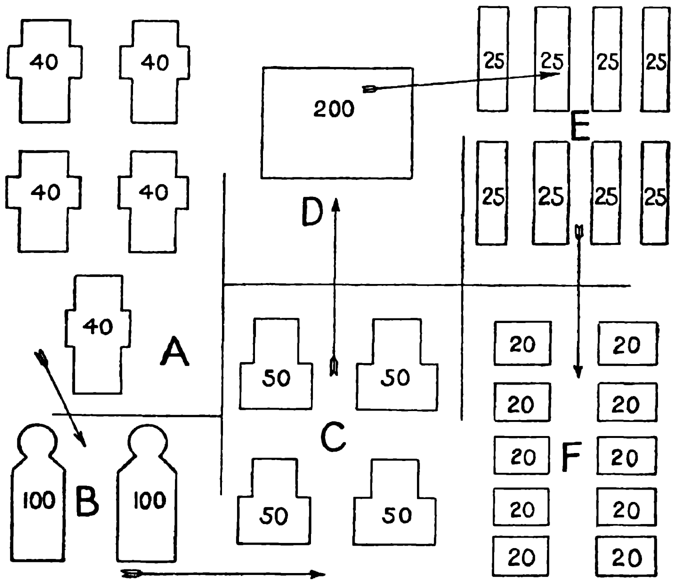


FIG. 18

Section C would run at a loss of 40 units
Section E would run at a loss of 15 units
Section F would run at a loss of 10 units, or D itself would be run at 200 units output.

If D were increased to 280 capacity sections A, B, C, E, and F would have to run at losses respectively equal to — 0, 20, 20, 20, and 0, and only by bringing each section up to 400 capacity would the same co-ordination be secured as for 200. The total capacity of the sequence of any manufacturing operations should be some common multiple of the individual machines, or of the production centres composing each step in the sequence.

HANDLING AND TRANSPORTATION IN LAY-OUTS

"Efficient works lay-out increases the capacity of a plant of a given size and is the foundation of economical production." The whole complex system which takes in raw materials and delivers finished products is one in which the human element is pre-eminent. The limit of production is that limit compatible with the well-being of the human forces. Those forces are fully effective only under suitable industrial environment;[1] hence, maximum efficiency in production is influenced greatly by the fact that the psychological effect of a correctly designed system is a potent factor in the maintenance of human efficiency.

There should be no cramping of shop space. The Factory Acts demand a minimum of 250 cubic feet of space per man. In engineering shops, however, the space is more than sufficiently large in comparison with the number of men engaged. Transport should be eliminated as much as possible. Professor Jones states: "The ideal in handling economics is to have the final position of a piece of work, at the conclusion of an operation, serve as the initial position for the next operation. As such a condition is rarely attainable, the general ideal should be to reduce journeys between tools as far as possible. . . ." [2]

In the lay-out of shops, with the intention of eliminating transport where possible, a problem arises as to the proper location for work of a given kind which occurs again and again at different stages in the process of manufacture. Should machines of the same kind be installed in different shops or should all work of a kind be done in one place, shifting the materials back and forward? The usual solution is to compromise, "which means a straight-line movement of materials when they are handled in quantity, while at the same time expensive units of equipment are kept in operation as steadily as possible." [3]

[1] T. H. Burnham, *Engineering Economics*, p. 200.
[2] Professor E. Jones, *Administration of Industrial Enterprises*, p. 62.
[3] Professor E. Jones, *Administration of Industrial Enterprises*, p. 63.

The first case, however, is the plan followed in mass production, and the second is usually employed in specialty manufacturing.

Production should never be impeded in any way; each move of the product between machines should as far as possible be actually a move forward. The movement of products from shop to shop should follow a one-way route.

Machines in the shops should be arranged so that adequate gangways are provided, both for the movement of men and for the storing of finished work and raw material. The machine shop in most engineering works is the principal shop in the lay-out. The erecting shop should adjoin the machine shop if possible; it is more advantageous to keep the erecting or assembling shop under the same roof as the machines, separated from them by a very wide gangway running the whole length of the building. In this gangway tool cages or the main tool store might be placed in, order that the tool service for both departments be one unit. Other sections feeding the machine shop should be so placed that transport will be as small as possible. Material stores and inspection department are best situated if they serve the machine and erecting shops in positions according to the movement of production; i.e. material stores adjacent to where the initial stages of the work are carried out, the inspection near the finishing stages. Adequate space must be given to stores, for work in progress, and for finished parts.

The type and shape of the building is decided by the nature of the manufactured product, and, to a great extent the shape of the buildings influences the particular form of handling equipment to be used, whether of conveyors, rails, overhead runways, or lifts. As the majority of engineering works are of necessity single-storied the question of lifts will not enter. Thus, before the design of the shops is finally settled, the exact system of internal transport to be adopted should have been thoroughly gone into and decided. Inadequately planned internal transportation may

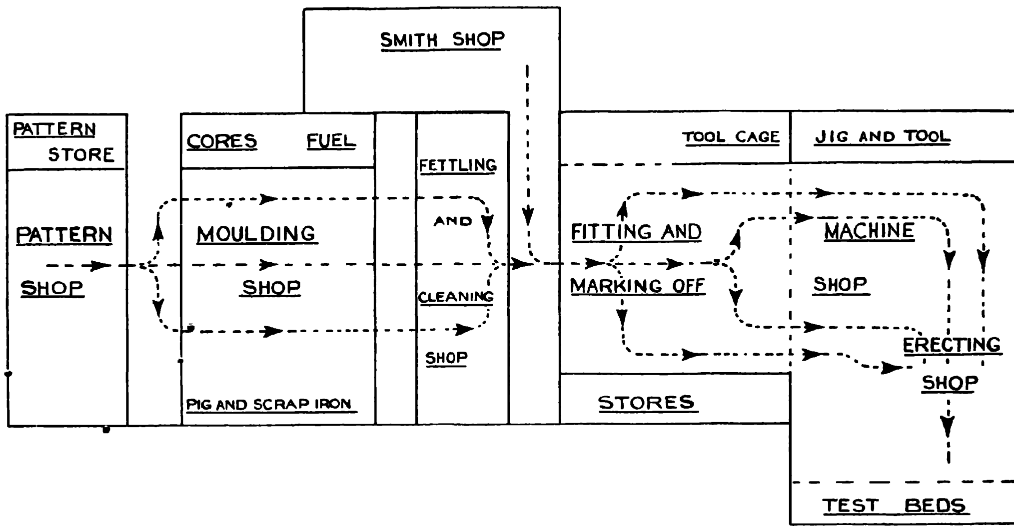

SMITH SHOP
PATTERN STORE
PATTERN SHOP
CORES
FUEL
MOULDING SHOP
PIG AND SCRAP IRON
FETTLING AND CLEANING SHOP
TOOL CAGE
JIG AND TOOL
FITTING AND MARKING OFF
MACHINE SHOP
ERECTING SHOP
STORES
TEST BEDS

FIG. 19

limit production capacity, or, because it is badly planned, a slowing up of the work will increase the costs of production.

The ideal straight-line system of transportation is unattainable, but transportation should be arranged so that the route never doubles back on itself (see Fig. 19). The handling of a product during processes may be defined as that necessary to get a piece of work from tool point to tool point. This may be divided into three main parts, viz.:

1. Single-movement handling from tool to transport medium.

2. Transfer trip to next delivery position.

3. Single-movement handling from transport medium to tool.

The costly elements in these handlings are those in the vertical plane; hence the aim should be to obtain the minimum number of vertical planes. The change through the vertical plane from one horizontal plane to another should be made in certain specified positions throughout the shops and by means of appropriate mechanical apparatus, i.e. elevating trucks or stacking machines.

In heavy engineering works this problem does not arise, as all lifts, or the great majority of them, must be done by travelling cranes. Even the final fixing of many articles on the machine bed can be accomplished only by means of overhead cranes. Transportation of this class of work is usually carried out on rail trucks, provision for which is made by the network of lines laid throughout the shops, or, in the case of transport through the machine shop, by the travelling crane itself.

In works where the volume of transport is heavy and made up of many separate articles, use should be made of continuously operating conveyors, or, in cases where necessary, of continuously operating lifts. Trucks are, however, much lower in capital outlay than a conveyor system. In general, it may be said that an efficient conveyor installation is only possible in new works, as the necessary modifications that existing buildings require for the purpose of

fitting conveyors are often impracticable or too expensive. Electric trucks are now greatly improved in design; their mileage per battery charge ranges from 15 to 25 miles, with a transport cost of a few pence per ton carried. Furthermore, an efficient truck system capable of negotiating curves and awkward gangways becomes more economical when compared with other systems of transportation which are limited by straight-line movements. Many types of electric trucks, either rail or without rail, are made suitable for lifting, tiering and other automatic work.

In conveyor systems, which may be either gravity-operated or power-driven, enormous developments have taken place during recent years. Two methods of using conveyors are well known. The first is that whereby the work of production is carried on while the articles are being moved by the conveyor belt; the second is where materials, tools, equipment, or finished product are collected or distributed by means of the conveyor. The former controls the rate of production and is in effect a method of minutely dividing labour. The speed of the conveyor sets the pace of work in the shop. "Conveyors on which assembling or other work is done are carefully timed to ensure an even output, and thus act as a governor on the rate of production. The rate of speed at which they move is the result of a careful time-study of each operation, which determines the rate at which any piece of work should be done without crowding men or machines beyond their efficient capacity. To have them move too slowly is sheer waste, but too much speed would be detrimental to the men and to the quality of the product as well." [1]

There are two divisions of assembly work performed on conveyor belts. In one no fitting or adjustment of parts is permissible; in the other some adjustment is necessary, the amount being dependent on the accuracy of the machine work.

The conveyor system plays a prominent part wherever

the principles of progressive production, with the necessary elimination of waste time, are adopted. This is nowhere more strikingly illustrated than in the modern motor-car works. Wherever possible, conveyors are used to render operations continuous, and they have been adopted for such work as heat-treatment, pickling, plating, painting, and other similar processes.

Natural Lighting

The width of a building and the height of its ceilings are dimensions which must be decided on with reference to each other for the purpose of determining the area necessary for light admission. Unless there is roof lighting as well, the greater the width the higher up the windows must run to give adequate centre floor illumination. Generally, 1 sq. ft. of window area suffices for illuminating 5 sq. ft. of floor space. Exact adjustments with reference to lighting must, of course, take into account the interruptions caused by pillars and other obstructions, and also the intensified light caused by white painted walls and ceilings.

Roof lights give about 75 per cent greater illumination than vertical windows. The slope of the roof lights should be 30 degrees or so; but as dirt collects readily on such a form of window construction a certain amount of gradual reduction of lighting efficiency must be considered. Sloping windows, unless cleaned, become about 10 per cent less efficient than vertical windows after six months.

The amount of light reflected from painted surfaces depends largely on the colour of the paint. Light paint assists the natural lighting of a shop, and saves an appreciable amount of artificial illumination, besides having a beneficial effect on the workers by giving them better light and more cheerful surroundings.

The approximate percentage of reflected white light from different colours ranges from 75 to 84 in the case of white, from 50 to 65 in the case of buff, and from 15 to 65 in the case of greys.

The curves shown in Fig. 20 illustrate the distribution of output in a mill from the beginning of January to the beginning of March. As the daylight in the working day increases, the curves become less irregular, output during

FIG. 20

Full line	,,	1st	Three weeks
Broken line	represents	2nd	Three weeks
Dotted line	,,	3rd	Three weeks

the beginning and end of a day approximating more and more to the normal.

ARTIFICIAL ILLUMINATION

Artificial light, in this latitude, must aid the workers' sense of sight for about 15 per cent of the working day. Hence, good lighting is important not only because it raises the standard of work, both in quantity and in quality, but because it has a direct influence on the health of the workers. Defective lighting causes many accidents as well as under-production. "If a workman loses 10 per cent of his efficiency during working hours because of poor

light, the wage loss would keep six lamps going during the entire day."[1] "Measured in terms of output, a 10–20 per cent higher level may be expected even when the costs of providing better lighting amount to only 1 or 2 per cent of the wages bill."[2]

Good artificial light is necessary for safe conditions as well as constant rates of production during night shifts. But good light is not necessarily bright light. The position of the source of light is a factor quite as important as its intensity. The illumination required for particular operations and working positions involves psychological and physiological considerations before a decision on lighting points can be taken, either for a new installation or for improvements to an existing system. The essentials of an adequate system may be stated: Sufficient intensity, correct diffusion and distribution, absence of glare, steadiness, and freedom from injurious invisible radiations.

The necessary intensity of artificial light varies with the nature of the work performed, the colour of the walls, the particular processes, and the raw materials operated on. For example—

Shops doing rough work .	1·25 to 2·5 foot candles[3] are required
Shops doing fine work .	3 to 6 foot candles are required
Offices require . . .	10 foot candles
Drawing offices. . .	15 to 25 foot candles are necessary
Special work . . .	25 to 100 foot candles may be used

The drawing offices should be particularly well lighted as regards both the day-time and the period during which artificial light is used. The lighting arrangements for yards, sidings, entrances, stairways, and other outside spaces are matters requiring careful study. Often the effectiveness of these serves to prevent accidents. For any dark outside areas through which production traffic passes the minimum illumination stipulated by the Home Office is 0·25 foot candle at ground level.

[1] Professor Jones, *Administration of Industrial Enterprises*, p. 95.
[2] Welch and Miles, *Industrial Psychology in Practice*, p. 96.
[3] One foot candle is the unit of illumination.

Lighting may be divided into three groups: General lighting, group lighting, and local lighting. In workshops general lighting combined with local lighting is preferable to group lighting, and the method of illumination should be direct rather than indirect.[1] With direct lighting great care should be taken to avoid the possibility of glare, which is particularly noticeable in cases where the light sources are placed low and provided with the old type of conical shade. Modern shades and reflectors, suitable for the bright gas-filled lamps now used, should be specified in the lighting plans. Special care should be taken to ensure "that the period of transition from daylight to artificial light is passed through without inconvenience to the workers."[2] Workers are sometimes irritated by the mixture of daylight and artificial light and often in cases of inspection, or similar work where colour discrimination is involved, the work suffers. The artificial light should be partially corrected towards daylight, which means that provision must be made for special globes where necessary.

A large amount of research work done by the National Institute of Industrial Psychology serves to prove that (*a*) an increase in illumination is generally followed by increased output, while there is a reduction in the number of mistakes made, in the amount of waste, and in the number of accidents; (*b*) waste of effort and loss of output and eyestrain occur if lights are badly placed; (*c*) efficiency is reduced by glare of lights or glare from polished surfaces of tools or materials. The following are one or two examples of each case.

Effect of Improved Illumination. An investigation conducted in a certain works proved that an increase of illumination from 3·8 ft. candles to 11·4 ft. candles has, in addition to providing improved safety conditions, increased the output by 8·5 per cent. The cost of the

[1] T. H. Burnham, *Engineering Economics*, p. 210.
[2] Welch and Miles, *Industrial Psychology in Practice*, p. 97.

improved lighting amounted to 0·04 per cent of the value of the increased production.[1]

Height of Lamps. By reducing the height of the lamps in the doubling room of a spinning mill from 10 ft. 6 in. to 7 ft. 6 in. and substituting 60-watt bulbs for 100-watt bulbs, the illumination at the working point was improved and the current cost reduced by £18 per year.[1]

Reflected Glare. In a tool factory workers examining small polished articles for flaws suffered from glare due to the reflection from highly-polished metal, and the detection of flaws was hampered by lack of contrast with the background.

A new sorting table was constructed with a container for materials at the back, and with a slowly moving belt, about 8 in. wide painted green, passing from the middle of the table surface and moving towards the front. The articles to be sorted were pushed on to the belt and examined before they fell from it into a container at the front of the table.

This device not only "reduced the strain on the sorters' eyes, but, by reducing the number of movements required for sorting, considerably increased the speed of operation."[2]

VENTILATION

Important economic consequences result from the condition of the air in a workshop. Inadequate heating and ventilation cause inefficiency through lowered vitality, sickness, and discomfort of the workers. Ideal heating and ventilation consist in the distribution of an adequate supply of air at the proper temperature and correct degree of humidity. Freedom from noxious gases and dust is essential. The main cause of discomfort occasioned by working in a shop badly ventilated is not the slight addition of carbon dioxide to the air—the traditional criterion of air quality being the percentage of carbon dioxide—but is due

[1] Welch and Miles, *Industrial Psychology in Practice*, pp. 99, 101.
[2] *Ibid.*, p. 108.

to the rate of heat reduction from the body to the surrounding air. Attention, therefore, should be given to the means of providing a pleasant and healthy atmosphere inside shops, independent of outside conditions. This may be done by determining the most suitable *effective temperature*.

The *effective temperature* or cooling power of air depends upon (*a*) rate of movement, (*b*) temperature, and (*c*) humidity. These quantities are measurable; hence the proper cooling power of the air may be determined; and, by a suitable instrument, the rate at which a human body would cool under particular air conditions may also be indicated. Standards of cooling have been determined for various types of industries, and for heavy, light, and sedentary work. If provision is not made for a workshop to maintain a pre-determined standard with respect to the air within it, then it becomes physiologically impossible for the workers to do their work satisfactorily without undue strain. Abundant proof of this fact is provided by comparative records of sickness rates, output, accident frequency, and labour turnover. Poor air conditions in certain industries may also adversely affect materials and machines.

The L.C.C. regulations stipulate that 1000 cubic feet of air per worker per hour is necessary. Six changes of air per hour would be adequate under normal workshop conditions. Where dust and fumes are dangerous to health, regulations exist to enforce their systematic removal. Here again it is easy to ascertain whether certain air is comparatively dangerous or whether any workshop is unsatisfactorily ventilated, but it is extremely difficult to design a ventilating system which is satisfactory from every aspect. And it is more difficult to devise methods whereby an inefficient system of ventilation may be improved. Often the mechanical operation is quite perfect, but other conditions obtain which nullify the advantage.

One-story buildings usually contain ventilators in the roof which, combined with windows or other forms of natural ventilation, may provide adequate air conditioning.

Where mechanical ventilation is employed the system may contain an equipment for air-conditioning, humidifying, air-washing, or dust-eliminating.

The system of heating the various shops will depend upon the temperature that is required, the capital cost, and the maintenance expense. Between 50° and 60° F. is approximately a comfortable average for the shops, but a higher temperature is necessary in the offices. In shops where much physical exertion is required, such as boiler shops, fettling shops, erecting shops, and so on, 50° to 55° F. would be high enough. Some of the sections would not require heating apparatus installed; the drying ovens and furnaces in the moulding shops and the furnaces in the smiths' shop keep the air temperature high enough.

The type of building, the outside wall area, window and door areas, rate of change of inside air, the number of persons, lights, and machines in the shop, and other factors must all be taken into account when designing a heating arrangement for the works. An ideal system is by indirect radiation and mechanical ventilation, since only about one-quarter of the heat used by a direct radiation system is required.

Depreciation

The complete undertaking, the design and structure of the plant, and the plan of the lay-out and the various machines and equipment, should not be greater in size than that warranted by the business available. "The fixing of the most economic size of a manufacturing plant involves the careful balancing of opposing factors." [1] Once fixed, departments may then be formed, the lay-out planned in as direct a manner as possible, adequate transportation arranged consistent with the minimum moving of materials, and convenient local points decided upon for tool services and stores. Two important considerations remain, viz. the question of depreciation and obsolescence in the works, and the future possibility of expansion of the undertaking.

[1] T. H. Burnham, *Engineering Economics*, p. 200.

Depreciation is a factor which must be borne in mind when deciding between alternative methods of construction. Both depreciation and obsolescence, while vital production factors, are often not recognized fully as such. The diminishing value of the plant and machinery results directly from these factors. The residual value is the value at the end of a certain period. This loss in value bears directly upon the economics of production and adequate provision must be made for it.

Depreciation can be defined jointly with obsolescence as follows—

Provision that has to be made in a works for the diminution in value of the working plant by reason of wear, age, and accident; also provision to enable the enterprise to take machines out of commission in order to substitute more modern and more productive machines.

The factors of wear, age, disuse, accident, etc., are dependent, to a great extent, upon other factors, such as handling, maintenance and repairs, and those alterations and additions which are necessary to counteract technical or ordinary obsolescence. The keeping of a depreciation fund is, in certain industries, of great importance; sooner or later obsolete machinery has to be replaced, or worn-out machines have to be made good, with a proportional outlay of capital.

In general, the estimated useful life of an industrial asset forms a basis upon which to calculate its rate of depreciation. For example, if the factory buildings will have a useful life of 40 years, then a depreciation rate of $2\frac{1}{2}$ per cent will have to be struck; while motor vehicles used for transport, with a useful life of four years, will carry a depreciation rate of 25 per cent.

Noise

Many pronouncements have been made within recent years on the ill-effects of noise upon human health and efficiency. Workers in textile factories, shipyards, boiler shops, and engine works seem to suffer no inconvenience;

but the exact nature of the necessary acclimatizing process they must undergo is unknown. Personal experience shows that a certain amount of resistance effort is involved and this effort is a continual, though at times, an unconscious one.

Research work done by the National Institute of Industrial Psychology in laboratory and other experiments, shows that there is a distinct tendency for efficiency to decrease when work is done under noisy conditions. The efficiency is reduced in proportion to the regularity of the noise, or with the degree of concentration required by the work. Manual workers contain the smallest proportion of those affected adversely by continuous or regular loud noises and mental workers the largest. Irregular or startling noises are always experienced as irritating and disturbing, and affect all types of workers in greater or less degree. Even where noise has no measurable effect on output or efficiency it may, however, cause considerable extra expenditure of nervous energy and so lead to premature fatigue.[1]

The noise problem may be divided into two main divisions: that in which the source of noise is proximate and can be entirely or partially removed, and that in which a certain amount of noise is unavoidable, like the noise emitted by machinery and most types of engineering equipment. In the latter case continuous investigation is being carried on to overcome the difficulties presented by this particularly difficult problem. The noise emitted by a machine presents two factors, one, whether the noise is in excess of a desirable or permissible standard, and the other, to find the cause of the noise with a view to modifying or reducing it. The human ear is not the ultimate judge of whether a machine is excessively noisy or not; apparatus must be employed to do this, in order to obtain quantitative results, to eliminate the vagueness of human judgment, and to analyse complex sounds.

[1] See *Industrial Psychology in Practice*, Welch and Miles.

The following experimental results show that noise may frequently cause fatigue and irritation and consequently affect output—

1. "**Machine Assembly—Noise, Output, and Waste.** A group of experienced workers assembling eighty temperature regulators produced some sixty imperfections. It was found that the room in which they were working was next to a noisy boiler shop. They were then moved to a quieter place, and immediately there was an improvement. They did 110 regulators in the same length of time formerly required for eighty, and had only seven imperfections."[1]

2. "**Clerical Work—Noise and Output.** The use of sound-absorbing wall material has been studied with reference to its effects on typewriting. When the walls of an office were treated with this material the output increased by 4 per cent."[2]

The effect of excessive noise on the workers in noisy machine and other shops is a matter for which there is at present no obvious palliatives. It is to the inside offices that efforts should be directed towards the prevention of distracting noises coming in from outside. Under ordinary conditions, office workers are generally as much exhausted by what they have to restrain in shutting out sense stimuli from external sights and sounds as by the useful labour they accomplish. The remedies must be thought of during the planning of the office buildings. Heavy construction should be utilized, forced ventilation if possible—thereby doing away with the necessity of open windows—rubber floors, sound-absorbing walls and ceilings, and all other factors which tend to counteract the effect of noisy conditions should be carefully considered.

[1] Welch and Miles, *Industrial Psychology in Practice*, p. 134.
[2] *Ibid.*, p. 135.

CHAPTER XI

ORGANIZATION

SUB-DIVISION OF HIGHER INDUSTRIAL FUNCTIONS

IN actual practice it is customary to subdivide the higher functions of industry into three main spheres of action—Direction, which is the highest control; Management; and Organization. Direction, or administration, in the strict and limited sense, implies briefly the inclusion of such problems as the establishment of the industrial enterprise itself, its relation to similar industrial undertakings, and its relation to the general industrial structure of the country. It also embraces the problems of guiding and co-ordinating all the diverse units or departments which form the complete business, and formulating the policy for that business.

Management is concerned with the same problems, but in a way which differs from that of administration in both degree and kind. In an analogous sense if direction is to an industry as the navigation personnel is to a ship, management will be the engine-room department. The administration will set the course, the management gets the industrial vessel over it. The two functions are inter-operative but they must work under different conditions; and the dovetailing of these two essentially separate but complementary functions into one harmonious whole is done by organization. Or, it could be stated that administration, directing the business policy, sets out to achieve the object through the management, using the organization as an efficient tool.

Administration or direction in an industry covers, in a narrow sense, that group of persons in the highest control, known as the directors. The directorate is recognized as being representative of control in operations which are,

generally, too large to allow of their being undertaken by private enterprise.

The directorate may take cognizance of many points which are not exactly identified with matters of policy. The function of administration may merge into that of management, depending upon how much more the managing director does in addition to exercising a general control over the whole enterprise. Mr. Oliver Sheldon suggests that, providing that the board of directors limits itself solely to co-ordination and does not control directly any particular aspect of management, the administrative function of the business stands clearly distinct from the managerial function. This is the case in larger concerns whose higher control is formed by a chairman and board of directors, together with a general manager or a managing director. Where there are several managing directors, or partners, there must be a certain amount of fluidity of function on their part, in the exercise of duties, between what comes under the scope of management and what comes under the scope of administration.[1]

Administration and management, as two distinct functions, cannot ever be identified together as one. The same individuals may perform duties under both headings, but it is "important that they themselves should distinguish clearly between the two roles they fill."[2] A small-scale organization does not require many individuals to share in a distribution of duties. A large-scale organization must, however, distinguish between the industry being administered and being managed. The duties which obviously come under administration must be determined and it must also be emphasized that any delegation of duties which directors should perform may be the root cause of inefficiency and perhaps the failure of the business. Directors frequently rely on the management to carry out duties which, strictly speaking, belong to themselves. On the

[1] O. Sheldon, *The Organization of Business Control* (Factory Organization). [2] *Ibid.*

other hand, "directors actuated with zeal often confuse in practice" their specific function with that of management —with results which tend to mar the smooth working of the enterprise.

The following list sums up briefly the duties of the directorate. They may be divided under two headings.

(A) To Determine Policies with Regard to—

1. A proper return upon the invested capital.
2. The security of the invested capital.
3. The provision and maintenance of the organization.
4. Labour.
5. Production.
6. Research.
7. Sales and Advertising.

(B) To Control Programmes with Regard to—

1. Guidance of management in the Production, Commercial and Financial divisions.

2. Lines of industrial development which are suggested by reason of the directors' knowledge of events which may affect their particular industry.

3. Assisting the company in various legal matters, financial and otherwise, which arise in all branches of business.

All the duties enumerated above primarily affect the prosperity of the enterprise; their efficient performance requires men of exceptional ability. The first seven points may be said to bear direct relationship to those duties which fall upon the directors as being representative of the shareholders. The remaining three are directly connected with the industry as an entity. While being in part a committee representative of the shareholders, the board of directors are in greater part administrative, and thus their loyalty should be to the industry as a whole rather than to the shareholders. There have been instances in industry where the interests of the shareholders and of the company have seemed to be at variance. In one particular

case money was held over for the purpose of supporting research instead of being paid out in dividends. The shareholders appealed to the courts and the case was decided in favour of the directors.[1]

It is not every director, however, who regards the welfare of the company as of paramount importance. There are many directors who not only make no administrative contribution to the industry but who hold directorates in other concerns with divergent or even opposing interests.

Administrative responsibility should be an essential requirement of all directors. Each director should undertake the specialized knowledge of one aspect, financial or technical, of the whole industrial enterprise, without, however, any actual performance of it. The executive performance will be correlated with the general administrative outlook of the board of directors.[2] As a unit, they will represent the shareholders in respect of finance and control, and their administrative powers will flow through a general manager or managing director.

Although companies seldom have the enterprise, the unity of purpose, and the quickness of action of privately-owned concerns, there are, however, instances when this is achieved, particularly where the board is dominated by individuals of outstanding personality and great organizing ability, who are able to enforce their own particular policy.

What is Organization?

It will be necessary to examine what is meant exactly by "organization" in industry. Industry itself has been defined as "human exertion of any kind employed for the creation of value," and in general this exertion is considered in its corporate aspect only. Industry may be recognized in the diligent man as an individual, but industry in the usual sense of the word holds the work of one individual in close co-operation with the work of others.

[1] Messrs. Brunner Mond, 1920.
[2] *Vide* J. Lee, *Industrial Administration*.

Judging from past undertakings on the part of mankind during the world's history sound organization has always been greatly in evidence. We have examples in organizations of the State—the Army, the Navy, the Police, the Civil Service—and of public bodies like the Craft Guilds and the Universities. The principles of efficient organization have now been clearly recognized, and they are adapted and applied under the ægis of Industrial Science.

Generally speaking, organization in an industry is that which co-ordinates or links together the functions of administration and management; or that which assigns to those spheres of action particular duties, collective and individual, and defines the scope and limits of all duties and functions. In other words, it combines the work of each department and every individual in such a way that all available forces for the work of production may be utilized with full efficiency.

The dictionary definition of organization states that it is a process of grouping and arranging into one whole a set of parts mutually dependent on one another, but each having a special function. Industrial organization aims to unite individuals into a body, and to provide the means whereby the efforts of those individuals will be directed rationally towards a common object. The common object is the manufacture of material into a specific product. This may be described as a digestive process, because just as in the case of the human body a functioning organism must be provided to keep the manufacturing enterprise alive.

The comparison may be carried further. Only with a sound anatomical structure can a body function harmoniously. Organization may be described as the anatomy of an industry; like the body it requires a continual care. Within itself it carries the seeds of its own decay and extinction; so the same care lavished upon an organization in the period of its inception must be exercised continually during its normal functioning. Neglected, an originally

sound industrial organization will rapidly degenerate into what is unsound. In analogy, within the human body the cells unite to form the organs which in turn work in harmony, receiving orders and direction from the brain; distress of one organ affects in some way all the others. Good organization will be only as sound and efficient as its separate parts, and the art of organizing may be described appropriately as human engineering.

Planning the Organization

The organization must be planned with great care and built to some definite design. The plan will not be stereotyped; it will vary with the type of industry—the form of organization used for shipbuilding would not be the best for the manufacture of motor-cars. It must be elastic as any changes in methods of working or type of product might entail some alteration of the organization which would result in a higher cost of production than originally specified. Any new activity arising within the industry must be capable of being fitted properly into an appropriate place within the organization.

The end for which an organization will be used as a means must, however, be definitely and completely known to those responsible for its plan and design, before any working plan can be evolved. And before an organization can commence to function, methods of work, operation and processes, as well as working tools, must have been decided upon.

The main framework therefore being clear, the innumerable details incidental to it will follow harmoniously in the plan if certain fundamental principles are kept in mind and the design is not in any way extended beyond the main thesis that the organization is to be the most efficient means to achieve one specific end. Having due regard to the size and purposes of the industry, the organizing executives build upon the framework around the enterprise the main body of the industrial structure consisting of the

complete system of channels and conduits through which the work of production flows; and the network of main conductors by which the current of authority reaches from the top to the bottom of the industry.

The sum total of the work to be done and the whole responsibility to be carried must be subdivided into different units by careful and proper analysis and distribution, so that both men and jobs are fitted together in the most suitable way. This analysis of responsibility and drawing of definite limits of supervision constitute the main girders of the organization. By the proper allocation of duties to the various individuals and departments, without overlapping, the methods of work are determined.

Individual responsibility must cover more than responsibility for the performance of specific duties; it must include the spirit of co-operation. The allocation of duties does not necessarily guarantee the accomplishment of the particular work involved, hence there must also be provision made in the organization for suitable and effective control.

Without co-operation and co-ordination it would be impossible to state whether the programme of production was being carried out effectively and economically. If the organization is suitable in this respect, and is sound, no failure to work to programme will escape detection and amendment. The co-ordinating activity must be materialized into a definite statement for all concerned, as to how the persons and departments are to unite, how the materials, machines, tools, equipment, plant, completed product and so on, are to be controlled; there must be a plan or a chart showing how these points are settled and defining the limits of individual responsibility.

An efficient organization is independent of individuals and is planned irrespective of the personnel, but specific work cannot always be divorced from the performer or performers of the work. They are not vitally distinct from each other, so the personal equation must have due place

in the question of the ultimate success of the organizer's plans. As was stated before, the appropriate union of man and job is an essential feature of good organization.

The personal equation is not the least essential quantity in the expression of good organization. In actual practice the information which the individual profitably makes use of, from his own knowledge of the organization, relates particularly to his immediate work and his direct superior. As the work of different special groups of individuals in the industry linked together forms various units, and the comprehensive activity of the organization welds those units into one cohesive whole, so each individual must be assumed to be capable of fulfilling his part effectively, if the total effort of all is to achieve the result planned by the organization. Hence, in order that no step in the work of production be frustrated through failure on the part of an individual, that individual must have the opportunity to learn beforehand everything that will have a direct bearing on the performance of his specific duties. In other words, the organization must solve the personal equation to the extent, at least, that no one will be left in doubt about his particular duty.

Principles of Organization

Line Organization. There are three different principles that may be used in organizing an industry, viz. the "line," "military," or "departmental" principle, the "functional principle" and the "line and staff" principle. The earliest form of organization was of the first type, and as a form of organization it still retains a large measure of its reputation for achieving results. Theoretically, it is a monarchical system deriving its strength from unity of command. Under modern conditions, autocratic control in an industry is impossible—except where the business is very small and the scope of each activity is inconsiderable.

Briefly described, the "line" principle divides the business into "certain self-contained departments." Authority

is delegated from the top, each departmental head being responsible for everything in his department, and the subordinate executives are required to undertake many varied functions. Under the control of a great leader and organizer this system will achieve good results, since it has the strength of dictatorship. There are, however, many

GENERAL MANAGER

MANAGER

Foreman Foreman Foreman Foreman

Workmen Workmen Workmen Workmen

FIG. 21. LINE ORGANIZATION

weaknesses and disadvantages of which the following are the more important—

1. It cannot be expanded very easily.
2. It depends solely upon the ability of a single individual.
3. Methods of work and control in one department may develop along lines divergent, if not opposed, to those held in other departments.
4. Work may be ineffective or restricted.
5. If relationship with other departments is ill-adjusted waste and inefficiency follow.
6. There is no incentive to the staff to render their fullest contribution, as stimulation of human effort is lacking.

The "departmental" system, in a growing enterprise, carries within it an obvious solution to the problem of an overburdened management. When managerial duties grow too large they are subdivided; under-managers are appointed and each given a section of the work. Each may develop his own professional practice, either similar to or widely different from the development of the same practice by others. Much waste and inefficiency is the result. If the "departmental" principle is to be the basis of an organization close co-ordination is essential. "The test of perfect co-ordination is equivalent marginal utility. The last doses

of labour force, executive attention, or invested capital applied to the various functions of an enterprise should bring in substantially equivalent profitable returns." [1]

The antithesis of the "departmental" system is the "functional" system. Mr. Sheldon says that under the former, work is divided according to processes or product and there is no distinction between functions. Under the latter each function is distinguished from every other, irrespective of products or processes.[2] The functional principle makes a clear distinction between and separates the planning from the execution of the work. It is division of labour applied to works management. Mr. L. V. Estes describes the functional system as one in which specific functions, common to all or several departments, are placed in the hands of men specially qualified for particular functions, so that instead of one individual giving attention to all the factors in one department he gives his attention to one factor in all departments.[3] The graphical illustrations, Figs. 22 and 23, may make this distinction clear; Fig. 22 showing the "Departmental," Fig. 23 the "Functional."

The "functional" principle is the most difficult to apply to industrial organization and carries with it great dangers. Co-ordination is of extreme importance and if the principle of "functionalization" is applied too thoroughly the result tends towards lack of co-ordination, and confusion; as well as incurring the probability that the best use will not be made of the abilities of the staff.

Modern conditions in industry demand, to a large extent, a complex organization. The principle used in organizing may be fundamentally simple in theory, but the application of it to industrial organizations is difficult. The ideal organization may be worked out satisfactorily on paper by analysing scientifically the total work to be done and then re-arranging on functional lines the resulting subdivision of

[1] Professor E. Jones, *Administration of Industrial Enterprises*, p. 144.

[2] O. Sheldon, *Factory Organization*, p. 40.

[3] *Vide ibid.*

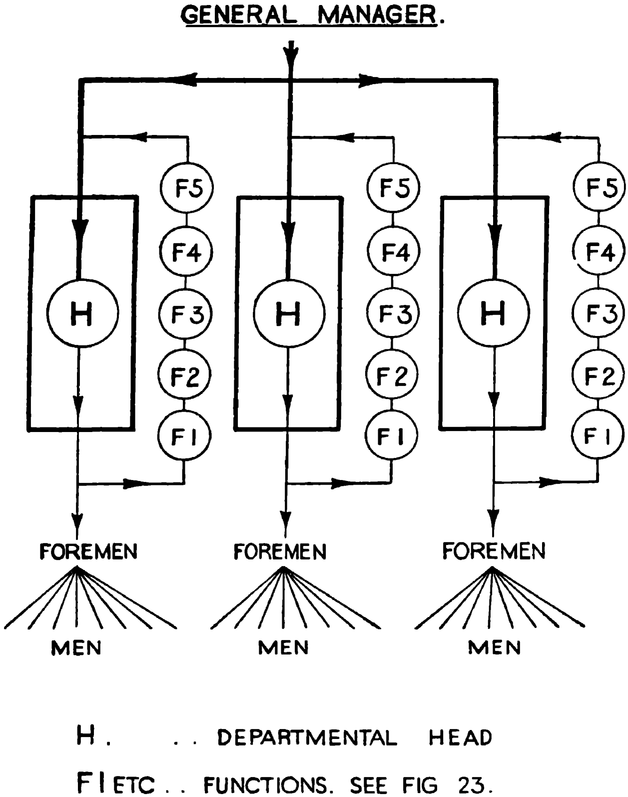
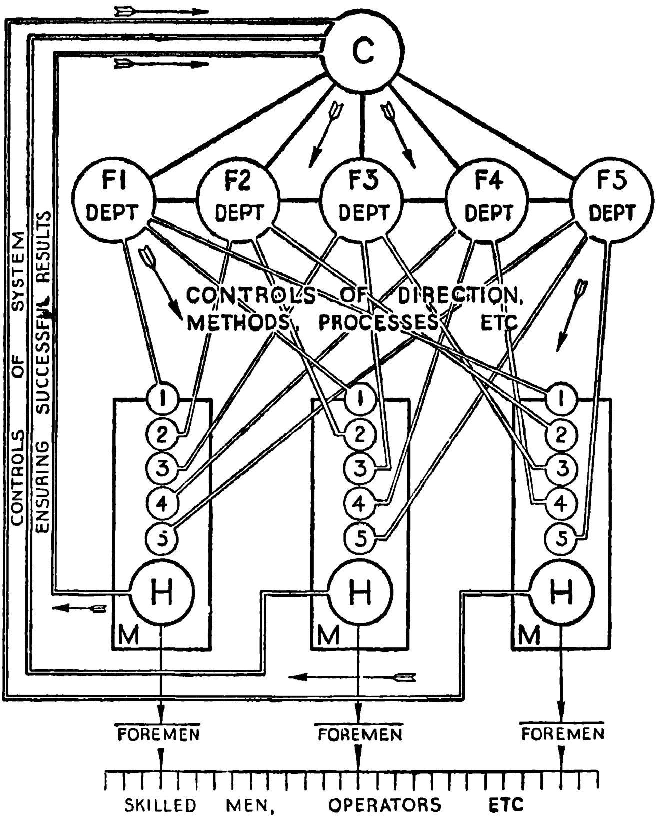


FIG. 22. DEPARTMENTAL SYSTEM

labour. But to do this, to replace completely an established "departmental" system, would mean so vast a change that the difficulties met with would be almost insurmountable.

Difficulties of greater or less degree would be met by introducing a distinct "staff and line" organization, the principle underlying which embodies a large amount of the "departmental" and "functional" principles. This system "distinguishes research and allied work from executive work,"[1] in contrast to the "functional" idea of separating

[1] O. Sheldon, *ibid.*



LETTER	FUNCTIONAL DEPARTMENT
F 1	PLANNING, SCHEDULING
F 2	PROGRESS
F 3	PERSONNEL
F 4	PLANT AND EQUIPMENT
F 5	PURCHASING
1, 2, 3, 4 & 5	RESPECTIVE REPRESENTATIVES OF ABOVE
C	CENTRE OF CO-ORDINATION
H	HEAD OF DEPARTMENT
M	MANUFACTURING DEPARTMENT

FIG. 23. FUNCTIONAL SYSTEM

each and every function. The "staff" part of the system assists the management on the technical aspect of production, thereby giving the executive side greater freedom for the supervisory work of manufacturing. Through the "line" part of the organization the authority is kept in strict order from top to bottom as in the "departmental" system. In many cases mixed systems are evolved in which authority is more widely diffused; skilled specialists on the staff side being in full authority in their own particular section.

Industries in the United States have specialized in "functional" types of organization, and considerable success has attended the development of this principle to meet the complex needs of modern industrial conditions. The tradition of British Industry, in the old-established branches, has carried the "departmental" system through to the present day. Hence, in the amount of overloading on the management lies the fundamental difference between British and American industrial organizing. Germany and France have, of late, given much more attention to this important problem than Britain. On account of this traditional financial proprietorship the introduction of any other system to replace completely the "departmental" idea would entail too many insuperable difficulties. Hence, the British method of modernizing existing organizations to meet the needs of the present conditions in industry is a compromise, i.e. a basic "departmental" system strengthened by certain ideas of "functional" and "staff and line" systems.

"Functionalization." Functions are the subdivisions of the three main divisions of manufacturing. These three main groups are the financial, productive, and commercial aspects of business, which are all interlinked and controlled by co-ordination. There is no possibility of going into detail with regard to the functional subdivisions, for the difference in industries and the differences in size, arrangement, and methods of plant and manufacturing would make a hypothetical example of little value. In actual

practice, every improved organization is the result of the growth of experience, and develops with the development of the enterprise itself. No ready-made system can be applied to existing conditions.

Every small-scale industrial enterprise is potentially a large-scale enterprise and its organization is a large organization in embryo. It is important to determine the precise form of organization for an industry, small or large, which will meet adequately the circumstances of modern industrial methods and the possible necessity for rapid expansion. For example, the organization of an enterprise in a new metal industry in Newcastle-on-Tyne, which began operations this year, had to provide for an exceptionally rapid increase in volume of business, plant and labour, during the first six months. The number of employees increased in that period by 2000 per cent. If the organization is planned to allow for gradual increase in business, drastic re-organization can be avoided; the expansion proceeds without any dislocation of the original organization.

In theory, the only way to meet those complexities introduced into modern industrial management is by "functionalization" in the system of organization. In considering the application of modifications to existing organizations, that is, those "departmental" in principle, there is much in favour of a "basic departmental system correlated by a functional system to include some of the features of the staff and line system." [1]

The essence of "functionalization" is the separation of different compact groups of intimately associated activities. It is not possible, however, to differentiate between particular functions, nor to define rigidly the nature and scope of any one. Certain duties and activities may be identified with one function in an organization, but may belong to a totally different function in some other organization. Nevertheless, any industry run on "functionalized" lines will have the same number of functions as another. The

[1] J. Lee, *Introduction to Industrial Administration*, p. 51.

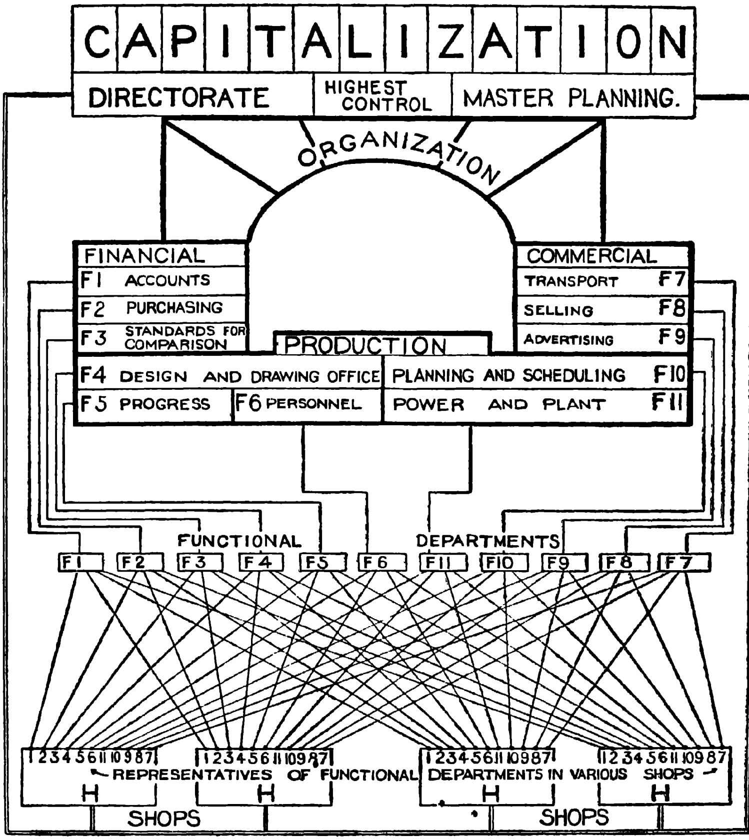
difference will be in the number of individuals to each function and the number of functions to each individual. A small functionalized industry will place one executive in charge of several duties, but each group of duties will be distinct.

The chart, Fig. 24, attempts to show the control of co-ordination over the three sections of industry, the financial, the productive, and the commercial sections. The sub-divisions, 1, 2, 3, etc., denote the headings under which specific jobs are identified. The whole diagram illustrates the general organization which links up administration with management.

The industrial organization has been subdivided over one plane by suggesting the functions which shall form the main structure of the organization. Each function itself must now be subdivided. This subdivision will determine the necessary degrees of responsibility by assigning definite areas of supervision for the individuals engaged. The areas subtended by the curve (Fig. 25) measured from the origin give an idea of the relative divisions.

In some aspects the division of responsibility will appear clearly defined, but in others the responsibility itself will be somewhat indefinite. The grading of officials, such as departmental managers, foremen, or technicians, gives corresponding degrees of responsibility according to the area of supervision. There are other officials whose particular activities carry a considerable measure of responsibility inasmuch as they may bear a direct influence upon the earning power of the company or may affect the number of major problems which arise in connection with the manufacturing processes. One particular example would be the duties of the chief designer or of a metallurgist.

Mr. Sheldon[1] suggests that much may be done in a scientific way in defining degrees of responsibility and areas of supervision, so that standards may be determined applicable to any industrial enterprise. Scientific analysis and grading of these subjects will be found to be, ultimately,



H... SHOP MANAGER OR DEPARTMENTAL HEAD

FIG 24

the means by which the work of production and the faculties employed to do it may be scientifically blended together, while preserving the goodwill and loyalty of the complete personnel.

Charting the Organization

An analysis of the required organization work having been completed, an organization chart may be drawn up. A single chart can frequently express more than a large amount of detailed written explanation. The analysis will consist of—

1. A determination of duties and responsibilities.
2. The means to ensure co-ordination and co-operation.
3. The subdivision of duties with proper regard to the human element in order that the work may be done effectively and economically, keeping justice and contentment in the foreground.
4. The possibility of expansion with ease.

In any works of importance the organization chart should be exhibited in prominent places, showing every employee to whom he is responsible and every executive who is responsible to him. In particular, the clear definition of duties and relations pertaining to persons of the organization being laid down, responsibility rests on the right individual. Failure to specify responsibilities encourages neglectful workers, foremen, or executives, and inevitably leads to a certain amount of confusion in the organization.

The scope of different functional services or departments may be considered in greater detail. In discussing the duties and responsibilities of particular departments, it may be understood that a connection will exist between each; in addition the idea is kept uppermost that they are being treated as part of the ideal organization which might serve for an average large-sized engineering works.

The determination of the ideal organization requires much more than a wide experience in organizing. Nearly all good organizations are made so by being modelled

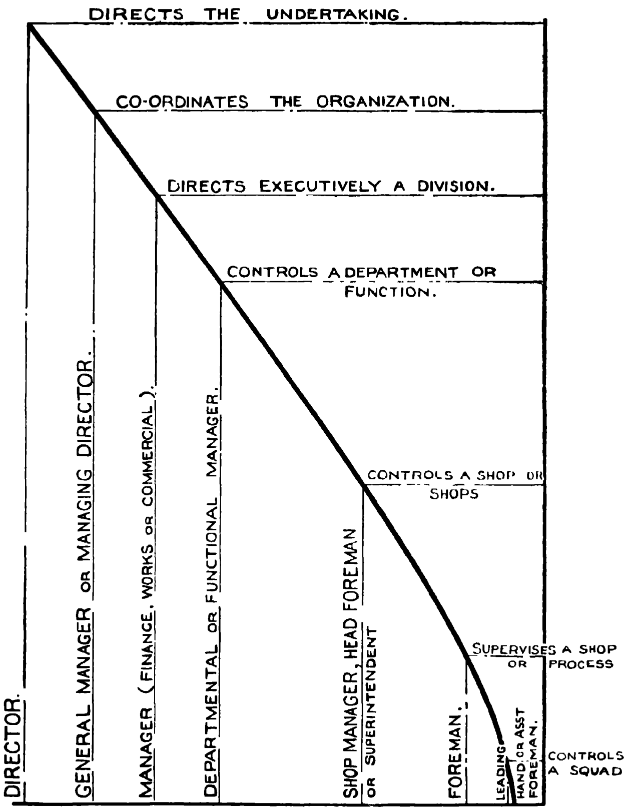

DIRECTS THE UNDERTAKING.
CO-ORDINATES THE ORGANIZATION.
DIRECTS EXECUTIVELY A DIVISION.
CONTROLS A DEPARTMENT OR FUNCTION.
CONTROLS A SHOP OR SHOPS
SUPERVISES A SHOP OR PROCESS
CONTROLS A SQUAD
DIRECTOR.
GENERAL MANAGER OR MANAGING DIRECTOR.
MANAGER (FINANCE, WORKS OR COMMERCIAL).
DEPARTMENTAL OR FUNCTIONAL MANAGER.
SHOP MANAGER, HEAD FOREMAN
OR SUPERINTENDENT
FOREMAN.
LEADING HAND OR ASST FOREMAN.

Fig. 25

largely on the particular necessities of the enterprise, and on the resolution to ensure that the fullest use is made of the qualifications of the available staff. Hence, at the present stage of development of industrial science, no ready-made or hypothetical system of industrial organization can be applied to suit the peculiar needs of each or any industry.

PLANNING

In any organization for manufacturing there is somewhere within it an individual who has to think ahead and to devise ways and means of working. If he has to bear responsibilities arising from other executive duties, no portion of his work will be carried out with maximum efficiency. It is an important consideration whether an economic necessity is provided for in the establishment of a special department or the delegation of one official in the organization to deal with this part of the work, viz. planning.[1]

Modifications in existing organizations have been widespread, due to the promulgation of scientific facts which followed the recognition of an actual science of industrial administration. The principal modification related to planning, and in the modern industrial organization the planning department has been placed on the centre line.

Planning and thinking ahead are characteristic of any well-organized business. Hitherto, the efficiency and economy of production—which are dependent upon the amount of plan and forethought exercised for the needs of production—were governed by the type of individuals forming the management. In most of the older-established British industries, especially engineering, the management is overloaded. This is but the logical outcome of earlier conditions when management was synonymous with ownership, and took upon itself all sorts of varied responsibilities such as planning, purchase of materials, progress of work,

[1] T. H. Burnham, *Engineering Economics*.

as well as being intimate with all technical processes and claiming to be the ultimate technical authority.

If the management is overburdened it is obvious that much of the extra and increasing expenditure of mental energy, outside that required for the actual work of production, can be reduced by the separate and systematic predetermination of the needs of all the employees who contribute to the different processes of manufacture.

The control of manufacturing operations becomes positive only when there is a separation between the planning of the work and the execution of it.[1] The planning department will increase the clerical overhead, but by anticipating the requirements of manufacture in advance greater output is secured per unit time, and hence manufacturing costs are reduced. Planning must commence with the design of the article to be made, and the most economical way of production can only be thought out by men experienced in and possessing a high degree of knowledge of the necessary manufacturing processes. For instance, after the drawings have left the drawing and designing office it is possible for those determining the processes to suggest slight modifications in the design by which simple operations could be utilized in the production, and hence reduce the manufacturing costs. In planning, every operation and its cost must be determined before any work commences, the materials must be specified, and a schedule of work drawn up. Instructions for each operation have to be made out, and if possible the complete work of production should be systematized and used as a production standard for the particular product. Having to plan, after production has started or when difficulties arise, seriously impairs efficiency of production: it also raises the manufacturing cost.

Where the industry is gradually increasing in size planning and scheduling activities may be divided among special

[1] J. W. Wardropper, *Organization of Production* (Factory Organization), p. 102.

officials who share the control, and special departments which will deal with the work. The principle of "functionalization" expedites planning and scheduling activities. and in large organizations this principle is utilized to advantage; in small enterprises provision should be made for separate planning, because with the expansion of business sooner or later the limit of capacity of the overburdened works management will be reached, and the formation of a separate planning department will become an economic necessity.

The planning department is equally essential whether the work of production is carried on in separate orders or on mass-producing lines. In the British engineering industry such departments are now fairly general, but their adaptation to existing organizations was the result of the success of the most elaborate planning arrangements, of American and continental industries which emphasized an increased economy of production, efficiency, and competitive power and showed that planning—as a separate function—undoubtedly renders a real service, especially in large-scale production.

The nature of the product of any particular factory largely determines the extent of the planning function, as it is directly affected by the technical character of the processes and the methods employed in manufacturing. There are, however, fundamental points which apply to any work being carried out "according to plan," just as certain fundamental principles of organization are applicable to all industries, however diverse in nature.

One potential danger must not be overlooked. Planning, if carried to excess, tends towards the conception of a manufacturing organization turned into an ingenious structure of men, machines, and routines, which becomes entirely mechanical; thus it ultimately defeats its own object.

As a function, planning forms the contact between the production division and the commercial. It will be respon-

sible for the preparation and issuing of manufacturing orders for finished products.

In greater detail, the responsibilities incurred may be set down—

1. Orders for necessary quantities of materials for manufacturing and supplies in the works (except fuel, such as oil, coal and coke). This will mean that, after requisitions have been made, the department must schedule the deliveries of the purchases to the works stores and ensure that the materials are on hand when required by the different shops.

2. The control of the materials from time of delivery until issued for use, including storage, stores records, size of raw material stocks.

3. Analysis of orders for work and the schedule for the delivery and completion of each order placed on the firm.

4. Cost analysis and general schedule for all new orders received.

5. The establishment of quantity standards for economical production—fixing of standard methods, times, and outputs.

6. Functional supervision over any other planning and scheduling that may have to be done throughout the works.

7. Co-operation with other functional departments, where necessary, in preparing budgets for materials and labour.

Progressing

The instructions of the planning department must be carried out in an adequate manner, and the order of work must be kept within the prescribed limits of time. The means of assuring that this is done is provided within the organization by the progress department. The progress department will look after and take responsibility for the following items—

1. Setting of works' shifts and hours of work.
2. Maintenance of works' discipline.
3. Keeping production within specified costs.

4. Maintenance of "Works Production Records" which will be necessary and informative of the condition of the work in hand and of uncompleted orders at all times.

5. The size of the work-in-hand programme.

6. The responsibility for the manufacture on scheduled time of all products ordered. This entails planning and arranging for the correct materials and components, and that labour and tools are available before the work is due to commence. It must also pre-determine the necessary order of processes, taking care that sequences of work are synchronized so that no hold-ups occur due to delay of any part; in addition, there must be a system whereby jobs which are, relatively, not urgent may be held back. The department takes responsibility for the quality, the quantity, and the complete production of the finished article.

7. Delivery of finished products to the stores up to standard specification.

8. Maintenance of the financial records of the work finished. These include all wages, all expenses incurred, and the value of the material delivered to the stores.

9. Maintenance of planning, scheduling, preparation, and inspection standards.

Mr. Burnham describes the relation between the progress department and the planning department as one of mutual assistance and co-operation. Any causes of delay or lack of balance in the different processes are reported to the planning department in order to obtain greater productive capacity at the points concerned. Hence the progress department must be able to show at any time the discrepancy between the pre-determined production and the actual production, and to indicate where the cause of the shortage lies. If the aims of either the planning department or the progress department are not being realized, then the other must co-operate until the situation is rectified. With an efficient organization the progress department will be

flexible and of vital importance in the administration of the whole works organization.[1]

Drawing Office

The planning and progress departments are specially concerned with the effect of particular designs upon manufacturing costs. Therefore, the position of the designing and drawing office in the organization is one of extreme importance. The chief designer in many works exerts probably the greatest influence upon the prosperity of the firm.

The drawing office, represented by the chief draughtsman or chief designer, must co-operate with the planning department, such as by utilizing any suggestions for modifying the product design which may result in reduced costs of production, and in particular must be able to balance, to a very fine degree, quality and efficiency of product with low costs of materials and production.

In works where a separate planning department is not established, the drawing office acts in much closer co-operation with the shops and with the purchasing section. Drawing office specifications will be definite and precise, and the information given on the drawings will be complete even to the most insignificant detail.

In brief, the responsibilities of the drawing office include—

1. The design and specifications of the product to the satisfaction of the interested parties.

2. The drawings for tools, jigs, gauges, machinery, etc., where necessary.

3. Specification costs and works' allowance.

4. Development of cost reduction in the product and in the manufacturing. (Co-operating with the inspection department.)

5. Standards for finished articles, raw material, and labour.

6. Mechanical tests of finished product.

7. Models, if required, for new products.

[1] *Engineering Economics.*

8. Provision and maintenance of all plans and specifications.

Plant Maintenance

Successful organization of manufacturing processes is nullified or dislocated if a breakdown or stoppage of any kind occurs. From the economic point of view it is essential to devote the greatest attention to the plant and equipment, in order to keep them at the highest pitch of efficiency possible. Power, lighting, water supply, and other necessities for manufacturing by machines or processes, are controlled, in very large works, by the plant-maintenance department (the work being often subdivided under the headings mechanical, electrical and civil engineering) and by the plant engineer in smaller undertakings. The whole work of the department bears a direct influence on the achievement of scheduled outputs.

It would be possible, in very large industrial undertakings, to separate the power problems from the plant-maintenance problems, in order to obtain greater efficiency. The two sections will operate as one, but a line of demarcation will exist between the responsibilities of each. The power section will be responsible for the requisitioning of coal, coke, fuel oil, lubricating oil, and water supplies, also the purchase of extra power where needed, such as electrical and compressed air. It will be responsible for the storage of the coal and other supplies. Other responsibilities include—

(*a*) The general supervision of the use of the power throughout the plant with a view to effecting economies and eliminating all possible waste.

(*b*) The generation, transmission, and metering of the power required.

The plant-maintenance department looks after the repair and maintenance of the ground and buildings, and of the machinery and mechanical and electrical equipment. It also manufactures the necessary tools, gauges, jigs, fixtures,

dies, and whatever else may be required for the work of production. It must approve of shop lay-outs, arrangements and rearrangements of machinery, location of machines and equipment, and must be responsible for all that is demanded by the Factory Acts and insurance companies. The responsibility of the plant-maintenance department will extend to all transportation and to the delivery of material to the shops, and the custody of unused or unwanted machines and equipment in the stores. It will operate whatever system is required for the issuing of the more important tools, the telephone system used throughout the works, and of watch-keeping over offices, closed stores, and unused buildings. It will be responsible for repairs on all power-transmission lines in accordance with the line of demarcation decided upon with the chief of the power department.

This division of supervision and responsibilities would be in most instances, arranged something like the following—

Section	Power Department	Plant Maintenance Department
Steam power	Inspection of pipe lines, and meters.	All repairs.
Heating (steam, water)	Inspection of lines, maintenance of correct temperatures.	Repairs; notification as to whether heat is wanted or not.
Electricity (heat, light, power)	Maintenance of leads up to building walls, including meters.	Maintenance of leads and equipment from building walls.
Oil fuel	Inspection of pipe lines, including meters.	Repair and clean.
Gas	Do.	Do.
Water (from water supply company)	Inspect meters.	Repair pipe lines.
Wire mains		Repair.
Telephone service	——	All.
Sewers and drains	——	All.

INSPECTION

In the matter of control of materials, especially from the aspect of inspection, independence is a desirable factor. A separate inspection department should not be arbitrary

in its independence, but should work in co-operation with the production and commercial divisions.

In detail the inspection department will be responsible for the following.

1. Inspection of the quality of all commodities delivered to the stores, such as—

Finished products, and packing;

Components of finished products;

Tools and other apparatus, the condition of which would affect the quality of the saleable product.

2. Inspection where necessary during manufacturing to maintain the quality, or to prevent the placing of good work upon damaged or bad work. It will have authority to stop all production until defective manufacturing conditions are rectified.

3. Supervision and maintenance of inspection standards and the provision of samples for specification standards.

4. Quality of materials purchased for works' use.

5. Rejection of defective material or product, and the disposal of that rejected.

6. Co-operation with drawing office in establishing or revising specifications for reduction of cost and quality of product.

PERSONNEL

"The economic advantages of the study of personnel cannot be exaggerated." Many industrial enterprises pay little attention to the recruitment, treatment, and use of the men employed in the works. It is, however, realized by the more progressive executives that more attention should be given to the problem of personnel, and that the old-established system of the foremen selecting the required extra hands from the factory gates is utterly uneconomic. An efficient recruitment policy is essential if a suitable type of worker is to be obtained. Also, it is well known that almost the total number of new employees have to be "carried" for the time that must

elapse before they attain any measure of proficiency. A new hand often gets a certain amount of rough and ready training from the nature of his immediate duties and from his workmates, but at the most it is unsatisfactory. Frequently he contracts faulty methods of doing the work.

This point is important. The present decaying system of apprenticeship is leaving nothing to replace that guarantee of proficiency in specific trades which held a very definite meaning in industry a generation ago.

The problem of recruitment and training will be discussed in greater detail in a later chapter. For the present it is sufficient to emphasize the economic necessity of a personnel department or—for small works—an employment manager. The responsibilities and duties of a personnel department may be briefly mentioned—

1. All employment.
2. Clearing of discharged employees with regard to unemployment and health insurance returns.
3. Setting and maintaining wage rates if no union rates apply.
4. Workmen's Compensation Acts and all regulations pertaining to them.
5. Control of passes for workers.
6. Hospital and medical service.
7. Educational activities, including training for new employees.
8. Pensions and service awards.
9. Recreational activities.
10. Any works' publications.
11. Sales and loans to employees.

Headquarters Staff Department

An important department will be formed to carry out those duties and responsibilities which are the essential part of co-ordination. That is, provision will be made for master-planning, for office control, and for the organization and

designation of duties. It will be a headquarters staff department, co-operating with and assisting the operating departments in matters relating to—

1. Selection of personnel.
2. Development and installation of systems.
3. Determination of management duties.
4. General management inspection, including control statistics.

Purchasing

It is not proposed to enter into the same detail with regard to the subdivisions of the commercial and financial sections as was done with the production section. There is one function, however, in the financial section which must be considered in a certain amount of detail, since whatever the form of organization adopted the purchasing problem remains a constant. Furthermore, in the type of organization that is being kept in mind throughout these paragraphs, the purchasing department will be responsible for the buying of everything for the works; it will also co-operate with the planning department in materials storage, and the methods used for storekeeping.

The complexity of the purchasing problem in the organization must not be overlooked. In the first place it varies with the nature of the industry, since in one instance a business may use materials of standard or staple commercial quality; and in another the business may be dependent upon materials which fluctuate wildly in price and the quantity available. Purchasing also directly affects the finished quality of the work turned out by the shops. Hence, as a function, purchasing should be controlled as effectively and economically as the production itself.

Hitherto purchasing has been regarded—by small enterprises—as one phase of the duties of the works manager. In larger concerns, it has frequently (when under the control of the commercial manager) been invariably out of touch

with the practical operations of production in the shops. Purchasing, however, must not be regarded as a phase of production; it requires independent attention; but the exact scope of the purchaser's or purchasing department's authority is difficult to define. Two facts are clear: (1) Purchasing is an essential part of the organization for production; (2) In purchasing, three main factors must be balanced, namely, price, quality, and time.

The chief duties of the purchasing department, in supplying the needs of production with the proper quantity and quality of materials at the proper time and at the correct price, are—

1. To be responsible for all expenditure.

2. To have complete control over all purchasing activities.

3. To have frequent recourse to consultations with the drawing office and other technical departments of the firm.

4. To be governed by the views of the planning department.

5. To decide which, among a range of grades of any given materials, are best for the job. These will not necessarily be the best or cheapest grades, but those which will give satisfaction at the lowest prices.

CHAPTER XII

MANAGEMENT

WHAT MANAGEMENT IS

MANAGEMENT has been defined by Dr. Taylor as the art of "knowing exactly what you want men to do and then seeing that they do it in the best and cheapest way."[1]

In the widely accepted sense management is that group of activities which may be described as an unseen creative force driving the industrial vessel along the course set out by organization. The activities are centred in a varied yet a homogeneous body, consisting of all persons who hold responsibility, in any degree, in the industrial organization. Each member of the body is a specialist of some kind and stands in a distinct relationship to each of the other members; while the successful operation of the whole industry depends upon all members working together as a compact and balanced unit.

The managerial body represents two aspects of the industrial undertaking, technical and non-technical. Its activities under the former are referred to, briefly, as production and, under the latter, as commerce and finance. Management, as one harmonious whole, carries out the industrial policies formulated by the administrative function, and while controlling and supervising the available means to that end it contrives to earn the maximum possible profits.

In this chapter the production aspect of management will be considered at greater length than the commercial and financial. There is, however, very little difference in degree of importance between the technical and non-technical side of any large industrial undertaking.

[1] Dr. Frederick Taylor, *Shop Management*, p. 21.

Distribution and finance involve all the complex ramifications of modern advertising, modern costing, and statistical work, and many other highly-specialized commercial and financial problems, which are, in certain instances, far beyond problems of production.

The inclination in older-established British industrial works to overload the management has been noted above, but it may be that a reaction has now set in against the Victorian tradition.

The gradual growth of improvements in the adjustments of manufacturing processes to required products, the co-ordination of the entire mechanism of production, the division of labour and the changes in organization following industrial specialization, mass production, and industrial combination, have all found a common focus in the necessity of some centralized control in every industry.[1]

Modern conditions compel management to divide controlling activities between the technical and non-technical executives. Specialization in management has developed in consequence. The problem of dividing correctly the manifold activities of modern management can only be approached in a scientific way. The subdivision of the elemental parts of management must be precise; the carrying out of managerial activities under a scientifically devised scheme must be tested against the facts of experience and then standardized.

Management strives, while carrying out the policies of the industry, to earn the maximum profits possible. Hence, the vital problems confronting management are production, costs, and wages. The responsibilities incurred in these matters are, broadly, those which affect—

1. The control of production.
2. The purchasing of raw materials and supplies.
3. The installation and maintenance of the necessary machinery and equipment.
4. The control of the sales of finished products.

[1] T. H. Burnham, *Engineering Economics*, p. 162.

5. The making and maintenance of costing systems, accounts, statistics, and records.

6. The carrying out of efficient publicity campaigns.

7. The arrangements for all forms of transportation, both for internal and for outside distribution.

8. The maintenance of an efficient and adequate control of the personnel.

These problems reduced in scale were, during the earlier stages of industrialism, solved by capital itself. With the evolution of industrial complexity capital delegated them to management. It is inevitable that management should now be regarded as intimately associated with capitalism; and that management itself should regard as its primary function the material interests of capital. The real position of management, apart from its executive function in the industry, is that of an intermediary between capital and labour.

Management, properly defined, should be a professional service dependent upon specialized knowledge and expert ability in many varied spheres. At the same time it should be "conducted with professional standards of independence and integrity as well as training." As medical men study and depend upon their knowledge of anatomy in the fundamentals of their profession, so, too, the professional manager should have the anatomy of industry at his finger-tips.

The Modern Trend in Management

In modern industry physical agencies, wind, water, steam, electricity, have been used in turn as history proceeded. The task of utilizing natural forces to do the work to the best advantage has now reached a very high degree of intricacy. The inventor, at each stage, was supplemented by the engineer, as the inspiration of genius was never sufficient of itself. Exact knowledge and certain confidence derived from systematic training in engineering science was essential. "The engineer is the first scientifically trained man to be introduced into industry. He is the first representative of science to come into contact

with the autocratic rule of the practical man, and to begin the process of sifting methods derived from tradition with the instrument of controlled experiment. With his coming, and through his influence, there have been set up in industry new standards as to accuracy and completeness of knowledge, new conceptions of natural and economic law, new ideas as to the use of records and standards, and a new practice as to preliminary preparation, standardization, and the close co-ordination of functioning parts." [1]

During a century of industrialism the engineer had been responsible for the far-reaching development of methods of production and for the establishment of scientific principles and laws with respect to all material construction; it was to engineers, therefore, that industry looked eventually for assistance to replace empiricism in industrial management with accurately reasoned knowledge. The problem presented might be described as a problem of management engineering.

The movement towards solving the vital problems of production, costs, and wages was initiated by engineers. The foundations of the work done to increase the effectiveness of manufacturing operations by scientific methods, definite principles, and a formulation of the technique of management were laid between 1880 and 1890. The reasons for the emphasis laid on problems of management towards the end of the nineteenth century are easily seen. The average efficiency in the majority of industries was low.[2] And in many cases it was found that simple and obvious changes in the arrangement and progress of manufacturing work produced a considerable increase in output.[3] Many industries also were increasing the size of their plants to meet the growing demand for industrial products. This widened still more the existing distance between capital—represented by the management—and the

[1] Professor Jones, *Administration of Industrial Enterprises*, p. 125.
[2] About 50 per cent of possible efficiency. Professor Jones, *Administration of Industrial Enterprises*, p. 132.
[3] T. H. Burnham.

workers, and rendered necessary a greater area of supervision and stronger disciplinary measures. Incentives to stimulate the worker's interest and effort, other than trying to regain the personal touch—apparently lost for ever—were anxiously sought. Increasing competition, at home and from abroad, emphasized the necessity for a more systematic study of the men, the methods, and the machines in industry.

The relative importance of the main heads of production costs varies within wide limits. In the engineering industry materials on an average account for roughly 46 per cent and salaries and wages between 35 and 36 per cent of the total cost. In certain cases wages account for 43 per cent of the cost and materials only about 40 per cent. Overhead charges and other expenses account for the remaining percentage.[1]

The cost of materials may be said to represent the largest single item in the costs of production. Consequently, the responsibility of management in keeping that part of production costs as low as possible will entail "adequate attention being devoted to the proper selection, safe custody, and efficient and economical handling of the materials used. The processes and operations of manufacture are planned to secure economical handling; and in economical purchasing some of the greatest gains of management may be accomplished." [2] The control of materials costs is furthered by constant supervision of stores through the perpetual inventory system.[3]

The cost of labour constitutes almost as large a part of the cost of production as materials. Its calculation means the greatest amount of detailed work, since not only is the cost proportional to the productivity of labour, but it is directly dependent upon the efficiency. Hence it is necessary to analyse the financial effect of the management of labour

[1] *Further Factors in Industrial and Commercial Efficiency*, p. 81 (Committee on Industry and Trade)

[2] J. W. Wardropper, *The Organization of Production* (Factory Organization), p. 81.

[3] *Ibid.*, *Records and Costing* (Factory Organization), p. 235.

forces in details, such as accurate records of the time taken by individual workers on jobs, the amounts earned, and the quantity of work performed. Above all is the essential task of choosing the precise wage system to suit the particular manufacturing processes employed in the shops and to ensure minimum production costs. Management must be able to trace factors of productive inefficiency, such as excessive overtime and night-work, increases of high-priced labour and abnormal earnings, and be able to compare the economic value of individual workers or gangs of workers engaged on related processes.

The particular form of remuneration employed will be used to measure the efficiency of each worker, either daily or weekly. This knowledge affords a valuable method of control in the hands of the foreman, and is necessary data for the purposes of the planning department.[1] The cost of labour comprises not only the wages paid for actual manufacturing, but also the wages for maintenance, storekeeping and other indirect services, as well as clerical and managerial salaries. This total must be analysed with the necessary headings prominently set out in relative importance. Steps may be taken to rectify wastage, whether due to the planning department or to the foreman or to other service departments. The relation between the costs of indirect services and the cost of purely productive work might be described as a useful index of managerial efficiency.[2]

The exact amount of overhead charge is difficult to ascertain. The total cost of raw material and direct cost of productive labour may be calculated within a reasonable degree of accuracy. The remainder may then be vaguely accounted to the hundred and one factors which are identified under the title overhead, or oncost. These are divided into two categories, viz. variable and fixed charges. The former are due to the volume of business while the latter are independent of the volume of production.

[1] J. W. Wardropper, *Records and Costing* (Factory Organization).
[2] *Ibid.*

There is, however, a certain inelasticity in the charges which are proportional to the volume of business, that renders the establishment of a standard cost per unit of production difficult.

From the production costs analysis figures the management is particularly concerned to find whether the productive efficiency is being maintained, increased, or decreased, as well as to discover the location and extent of waste or unnecessary expense. Fixed charges have to be met without regard to output. Maintenance or renewals charges if postponed only relieve present production by burdening production in the future. Waste of human effort and materials as well as unnecessary expense are the chief factors inimical to economical production; and it can be said that the success of the management in reducing these factors to a minimum is to a large extent an index of its efficiency.

Efficiency of Management

The important element of most problems of production and costs in industrial administration is that of efficiency. That aspect is kept uppermost in all considerations affecting power generators, machines, processes, equipment, handling and transporting arrangements, and many other kindred manufacturing problems. The question arises whether it is possible to devise any accurate measure of the efficiency of management. In many cases it is satisfactorily answered by the profits earned by the management. There are, however, many other factors which enter into profits besides managerial efficiency. Hence, comparison of profits between standard types of factories is not a true index of efficiency. The ratio of actual profits to the potential profit-making capacity of the business would be nearer to the true index of managerial success.[1]

It is a traditional qualification required of management that it must be expert. Within recent years it has been

[1] T. H. Burnham, *Engineering Economics*, p. 174.

acknowledged that while management should be expert in the executive function of manufacturing, it should, for the particular needs of manufacturing, be dependent upon specialized technicians. "It is essential that the aspect of control which is essential to management shall not presume to be continued control of technical study and research. . . . The manager should realize that there is, or soon will be, a science of management, not necessarily dominant over the technical management, but so important as a co-relating medium as to demand his first attention."[1]

Within recent years there has been decided contact between science and industrial management. It has become increasingly apparent that a great stimulation is being given to the special field of industrial management by the application of scientific principles and methods of scientific analysis. In British industry, however, the readiness to change from traditional management is not widely shown. The great advance in industrial practice has, for the most part, turned the "expertness" of management into strenuousness. And strenuousness must never be confused with efficiency.

Aristotle subdivided his concept of efficiency into ten categories: (1) SUBSTANTIA is the foundation and structure of things, which means that the thing done should be good in itself; (2) QUALITAS, which means that the thing should be the best of its kind that can be produced; (3) QUANTITAS, that is, as much of it as possible; modified by (4) RELATIO, i.e. proportionately to the requirements of the case, neither too much nor too little; (5) ACTIO, or the proper management of energy; (6) PASSIO, or adjustability to environment; (7) UBI, that everything should be in the right place; and (8) QUANDO, everything at the right time; (9) SITUS, which means attention to detail, in order that the component parts are properly ordered, arranged, and balanced; (10) HABITUS, i.e. that the general get-up and finish of an article or action is complete. Thus, under the

[1] J. Lee, *Industrial Administration*, p. 49.

above subdivisions of efficiency, every perfect work may be brought; if there are imperfections in any work, they are due to some degree of inefficiency.

Inefficiency may occur in some, or all of the categories, due to limitations of the agent, or material, or opportunity. The commonest forms of inefficiency fall under the category of space and time, the effects of disorder and unpunctuality.

American industrial executives and industrial engineers sponsored the first definite attempts to unite the principles of efficiency with management. The facts and laws that underlie true efficiency were applied, and a new code of rules was drawn up which aimed to give greater precision and efficiency to all productive processes involved in manufacturing. These included problems, such as the best location and the best construction of plants, the most effective character and arrangement of machines, tools, and materials, the best methods of selecting and training workers and the nature and the exact amount of work that could be done by each man, the most remunerative system of payment in the interest of employer, wage-earner, and efficiency, and the most efficient manufacturing processes.

These problems involved the scientific method of thinking out the correct solution. As such, it differs from the older or ordinary method in degree rather than in kind. The result is an orderly, persistent, and thorough use of the mental faculties. It brings to bear on industrial problems the analytical methods of investigation employed in the sciences. Industrial management thus develops a science of its own, with well-defined laws which will replace the old and uncertain precepts of tradition and empirical opinions.

"In its essence, scientific management involves a complete mental revolution on the part of the working men engaged in any particular establishment or industry—a complete mental revolution on the part of these men as to their duties towards their work, towards their fellow men,

and towards their employers. And it involves the equally complete mental revolution on the management's side—the foreman, the superintendent, the owner of the business, the board of directors—a complete mental revolution on their part to do their duties towards their fellow workers in the management, towards their workmen, and towards all of their daily problems. And without this complete mental revolution on both sides scientific management does not exist." [1]

Scientific Management

Scientific management is a term which has been prominently applied within recent years to the detailed attention that modern industrial executives have been compelled to devote to the systematic organization, co-ordination, and regularization of production. Scientific management owes its inception to the work of F. W. Taylor in the United States. Dr. Taylor systematized working by determining the best ways of doing particular jobs, eliminating all unnecessary efforts, and reducing the workers' fatigue to an absolute minimum. Taylor was a true pioneer, and he made a great and lasting contribution to the science of industry. "He approached problems which had been thought either not to exist or to be easily solved by common sense, in the spirit of scientific inquiry. He worked patiently for years to satisfy first himself and then others that by careful observation and accurate timing, principles could be arrived at which governed the right employment of a worker's time and energy." [2]

In brief, Taylor's work contained three main factors, usually referred to as: (1) Time study, (2) Motion study, and (3) Fatigue study. These three factors constitute a system by means of which almost every manufacturing operation may be separated into its elemental parts, and

[1] "Hearings before the H. of R Sp Com. on the Taylor and other Systems of Shop Management, Washington, D.C" *Vide* Professor Jones, *Administration of Industrial Enterprises*, p. 10

[2] E. Farmer, Report 14, Industrial Health Research Board, p. 10.

by study, observation, and experiment of unit times and motions, standard methods, equipment and operating instructions are determined. The system also aims at the conservation of the physical and mental health of the worker in the daily and continuous performance of manufacturing tasks. From this, methods of payment are determined which give the worker a wage considerably above the ordinary and provide substantial rewards for attainment of the standard set and a definite loss for failure. By the elimination of waste material and effort, lost time, and idle machinery, and by the observation of the laws inherent in Dr. Taylor's system of scientific management, the maximum of efficiency for the factory and the employee is said to be assured.

Taylor drew attention to the fundamental importance of the systematic use of experience in management by insisting on the separation of the planning and the execution of industrial work. "Functionalization" was derived from the results of Taylor's recommendations of consistent planning, based on scientific analysis, by a special official or department. Scientific management became, in essence, a system of super-training based on the principle of planning by trained experts and execution by workmen who were directed in elaborate detail as to what they had to do, including even when and how they should rest. Also, Taylor insisted that the only equitable method of remunerating must be based on the quality or quantity of work accomplished.

Following the pioneer work of Taylor and the greater development of his thesis by H. Emerson and G. Gilbreth, scientific management became widely employed in American industrial organizations. Within recent years the principles of scientific management have been extended far beyond the original limits defined by Taylor, and its theories are applied to almost all aspects of manufacture, economics, commerce, agriculture, banking, and public-service administration.

Time and Motion Study

For the purpose of obtaining a clear insight into what "time study" really is, the words of F. Gilbreth, one of the pioneers in the field of scientific management, may be quoted: "Time study is the art of recording, analysing, and synthesizing the time of the elements of any operation, usually a manual operation, but it has also been extended to mental and machinery operations.

"It is one of the many remarkable inventions of Dr. Taylor, while he was working at the Midvale Steel Works. It differs from the well-known process of timing the complete operation, as, for instance, the usual method of timing the athlete, in that the timing of the time study is done on the elements of the process. Much ridiculous criticism has been put forward by well-meaning but uninformed persons, who claim that timing a worker down to a three-hundredth of a minute is unkind, inhuman, and conducive to the worst form of slavery ever known. On the contrary, obtaining the precise information regarding the smallest elements into which an art or a trade can be subdivided, and examining them separately, is the method adopted in all branches of scientific research." [1]

The basis of time study analysis is the successful application of the stop-watch or electrical recording machine. Each job is subdivided into its elemental parts and timed over an adequate period. Many of the elemental operations necessary in one piece of work will be found in others. These timed elements may then be made standardized units, and may be employed whenever possible for the time study of the new operations. Scientific management uses time study to obtain precise knowledge and accurate results, founded on careful investigations of both workers and machines, instead of determining tasks, fixing rates of remuneration, and times and other working conditions by guess-work or by general experience. "With accurate time knowledge as a basis, surprisingly large results can be

[1] Frank Gilbreth, *Primer of Scientific Management*, p. 7.

obtained under any scheme of management."[1] Time study must be used in close conjunction with motion study.

The primary object of motion study is to eliminate "wastefulness resulting from using unnecessary, ill-directed, and inefficient motions, with a view to achieving maximum economy of effort." The secondary aim of motion study is to "combine and co-ordinate successive motions into the natural rhythm," which is the most efficient way of doing a particular operation.

There are said to be three sets of variables to be taken into account in the study of scientific treatment of motion. These affect the worker, the conditions, and the motions respectively—[2]

WORKER

Bodily strength and health.
Nutrition
Tendency to fatigue.
Habits.
Mode of living—including sanitary conditions.
Size.
Skill.
Mental power and general intelligence.
Temperament—racial peculiarities or moral causes.
Contented disposition—including standard of living.
Wage incentives or reward and punishment.
Training and education (general and technical).
Wage-earning capacity.

CONDITIONS

Climate.
Appliances.
Heating, cooling, ventilation.
Lighting.
Surroundings (cheerful or otherwise).
Quality of material—size and weight of unit.
Tools.
Clothes.
Fatigue-eliminating devices.
Trade-union regulations and Factory Act laws.

[1] F. W. Taylor, *Shop Management*, p. 46.
[2] Frank Gilbreth, *Primer of Scientific Management*, p. 8.

MOTION

Acceleration and speed.
Automaticity and necessity.
Direction and path.
Inertia and momentum to be overcome.
Length.
Combination with other motions.
Effectiveness.
Cost.
Foot-pounds of work done.

A valuable research instrument for motion study is the high-speed camera, which enables the fastest movements to be recorded and analysed. The investigator in time and motion problems must be a competent research worker, well versed in the particular work under consideration. The operators studied must be skilled but they must avoid making any special effort beyond doing their normal best, in order that the records will allow of an equitable standard time to be fixed for the operation.[1] The variables taken into account by American scientific movement investigators rather overload the task of the average investigator. It would be impracticable to take all these factors into consideration, since workers vary on all counts to a very great degree. Professor Shields suggests that to get the best results, those conducting the research for the elemental movements in operation should bring a spirit of sympathy into their contact with the workers. The workers should be taken into the discussion and a clear explanation of what is being performed given them in order that they may willingly co-operate with the time and motion study investigator. Many workers, especially British craftsmen, have an instinctive habit of employing certain working movements of their own, and perform the task in a time that does not lead to fatigue during the working day, and at the same time do the requisite amount of work. "Every worker should be taught the standard method and then

[1] T. H. Burnham, *Engineering Economics.*

allowed to follow his own devices, provided that the results are satisfactory." [1]

Machine-tool work naturally lends itself to time and motion analysis, but to apply the same degree of investigation to fitting and all hand operations, and therefore to the human element may, if not tactfully carried out, do more harm than good. When time study was first adopted in the U.S.A. the absence of sympathy with the workers was so marked that legislative enactments prohibited, for a time, the use of stop-watches in connection with industrial or factory work.

It would be difficult to state definitely which aspect of scientific management produced the best results. Time and motion study might revolutionize one particular industry but prove a complete failure in another. Rest pauses or reduced hours for the workers might increase the efficiency of the majority of factories; on the other hand, scientific wage-incentive systems, whereby the workers would receive more money per week, might result in greatly increased individual efficiency. Dr. C. S. Myers asserts that Taylorism as originally defined "is unscientific because, obviously, no accurate information is available upon which the amounts to be deducted for the allowances made can be based. It is anti-social as it aims at excluding, as far as possible, the average workman. It is unpsychological since it is a measure of rate of work obtained under abnormal conditions and in circumstances that cannot fail to arouse an undesirable mental atmosphere throughout the factory."[2]

Scientific management does, however, present a rational attempt to put wage-payment systems upon an equitable basis because time and motion study can be used to prove that the payment of high wages is not incompatible with low costs of production.

[1] E. A. Farmer, Time and Motion Study, No. 14, Report of the Industrial Health Research Board, p. 18. *Vide* B. F. Shields, *The Evolution of Industrial Organization*, p. 114.

[2] C. S. Myers, *Industrial Psychology*, p. 83.

Fatigue Study

Taylor drew attention for the first time to the problem of industrial fatigue. His work showed that if continuous effort is expected from workers, temporary fatigue will follow unless due provision is made for rest periods at frequent intervals. The prevention of temporary fatigue will avert the effects of cumulative fatigue which are chiefly productive of inefficiency and lost time.

The problem of fatigue has a very general application throughout industry, and cannot be ignored by modern management systems. The fallacy that long hours lead to high output has, on the whole, been accepted as such since the war years. The unconscious tendency on the part of a worker to curb output as the length of time on a job increases is the natural instinctive husbanding of his energy to prevent over-fatigue. Experience shows that during the normal spells of four to five hours in any industry the workers invariably take rests, whether they are authorized or not. Enforced delays—such as waiting for materials, or by dislocation of equipment, as well as unauthorized rests—have very little recuperative value. When rests are sanctioned by authority the worker relaxes completely. It has been estimated that organized rests have more than five times the effectiveness of enforced delays or spontaneous rests. It has been shown also that the output increases not only after the organized rest pause but immediately preceding its occurrence.[1]

Fatigue is caused by the accumulation of toxic products in the blood. These products arise from nervous and muscular activity being continued over long periods without rest, resulting in an accumulative clogging of the tissues to such a degree that ultimately the human mechanism fails completely. Physiological research shows that longer periods of rest are necessary after night and week-end

[1] *Vide* H. J. Welch and G. H. Miles, *Industrial Psychology in Practice*, p. 8.

work than for week-day work only.[1] On the same grounds rest periods should be determined throughout working periods of the day according to the particular nature of the work and its influence upon the accumulation of poisons in the blood.

The pause must be long enough to relieve fatigue but not so long as to produce a reluctance to return to work. The best length for specific operations is usually decided by experiment. The usual test is to measure the variations in output; but experience has shown that other indices of fatigue, such as sickness, accident rates, spoiled work, labour turnover, and time-keeping are always reduced by any reduction in the length of the working spell to a value depending upon the particular industry and environment conditions.

The position of the rest period must be carefully determined. This is done to the greatest advantage by means of the work curve. The work curve properly analysed indicates the approach of fatigue, and the rest pause should be introduced just before the position of down flexion on the curve. Fig. 26 illustrates a typical work curve. Fig. 27 illustrates the increase of output resulting from a reduction in the hours worked per week, i.e. from 66·7 to 60·2 and subsequently to 55·5. The output in the 55·5 hour week exceeded that in the 66·7 hour week by 19 per cent.

THE PRINCIPLES OF SCIENTIFIC MANAGEMENT APPLIED

The effects of the general application of the principles of scientific management in an industrial undertaking may be briefly considered. In broad outline, scientific management seeks to get the maximum from methods, men, materials, machines, and money, and it controls the work of production from the location and lay-out of the works to the final distribution of the product.

Specialization, so distinctive a feature in modern industry, finds its highest application in the theory and practice of

[1] A. P. Fleming and H. J. Brocklehurst, *Industrial Administration.*

scientific management. Specialization applied to "methods," may be taken here, in the strict sense, as specialization in methods of production and cost; "methods" in its broadest sense embraces all other elements in the undertaking.

The keynote in manufacturing methods is struck by the

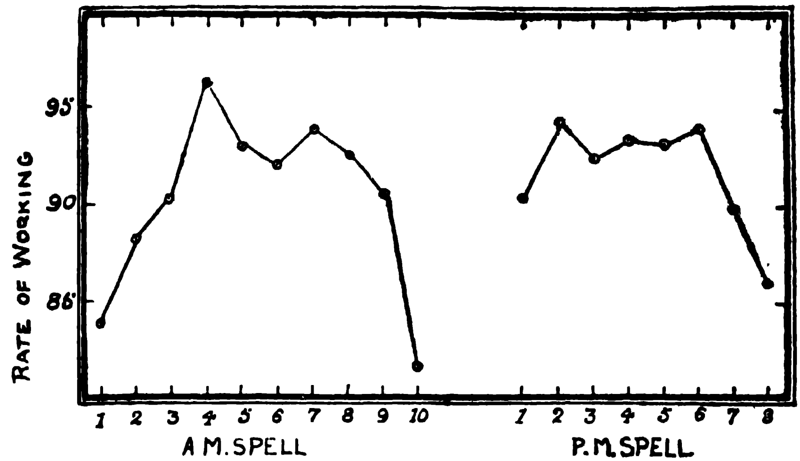


FIG. 26

planning department. In broad outline the planning department allows no order for production to be proceeded with until all materials, tools, equipment, and so on are ready; that the proper machines for each part of the work are arranged; and that transportation facilities are adequate for the planned schedule. It ensures that each day every man and every machine have sufficient work assigned ahead so that none will be idle for any period of the day. Everything of a routine nature is planned for, leaving the executives in the shops free for creative processing and the workers with no other function to exercise than the actual operation assigned to them. In other words, a few specially trained men, skilled in the elements of analysis "plan and analyse all work, methods, etc., and

prepare the way for the workman to produce at his highest normal efficiency." [1]

The one indispensable mechanical requisite in establishing a system of scientific management is the stop-watch.

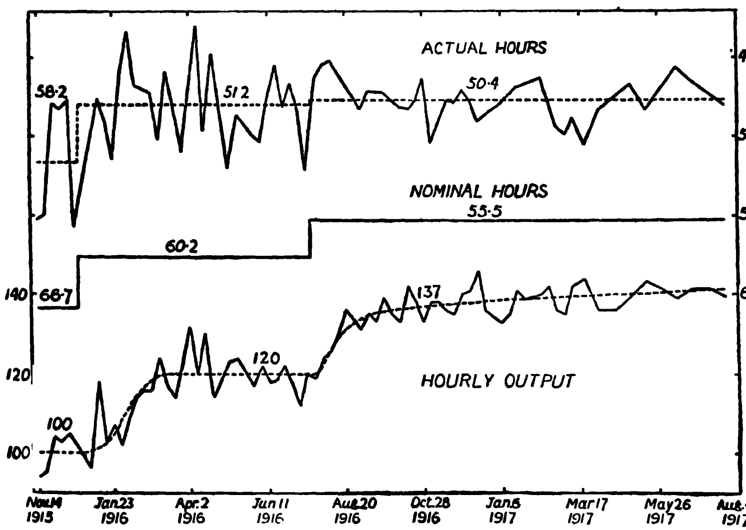


FIG. 27

Every operation is investigated scientifically; all waste movements and unnecessary effort are eliminated from the operation, and the final result is set as the standard. The conditions of the work are also standardized. By furnishing each worker with a specific job, with every operation elaborately written out so that mistakes will be practically impossible, the work, divided into its various elements, is done in predetermined times during its future progress through the shops.

In the place of one single foreman who is responsible, under the works manager or superintendent, for all matters concerning orders, men, materials, and machines in his shop, scientific management employs a number of functional foremen, each of whom is responsible for one division

[1] F. A. Parkinson, *Applied Methods of Scientific Management*, p. 38.

of the work. Usually, there are eight of these, four of whom are attached to the planning department, and four on the floor of the shops. Functional foremen have charge of a certain function in the handling of all the men instead of having full charge of a certain number of men as is the case of the usual type of foreman. Under the Taylor system of scientific management these functional foremen are—

1. Route clerk and order of work clerk.
2. Instruction card clerk.
3. Time and cost clerk.
4. Disciplinarian.
5. Gang boss ⎫
6. Speed boss ⎬ in workshop.
7. Repair boss ⎪
8. Inspector ⎭

The order of work clerk specifies what work is to be proceeded with and on what machines it is to be done. The instruction card clerk makes out the standard practice instructions on work cards, and when each worker receives his instruction card the necessary materials, tools, and equipment must be ready to his hand. The instruction card clerk also specifies the rates to be paid. The time and cost clerk conveys all information necessary to the men regarding their work or instructions, enabling them to make proper reports. He secures from the men the correct records and hence times them and calculates the wages and premiums earned. The disciplinarian acts for the whole works in dealing with cases of insubordination or unexplained absence from work, and exercises powers of suspension and dismissal. He settles disputes between different foremen and different men and, also to a great extent, arbitrates in wage adjustments.

The chief duty of the gang boss is similar to that of the old type of foreman proper. He controls the work until it is set up in a machine, and takes charge of it again as soon as the last tool cut is made. He must see that there is always sufficient work ahead and that the men are properly

instructed how to do the particular work assigned to them. The speed boss instructs the workmen as to the correct tools and the proper speeds, cuts, and feeds to use on machines. All time study work is in his charge, also the methods of determining bonus payments. The repair boss is responsible for the condition of all machines and production centres, the proper stacking of work, and so on. The inspector is responsible for the proper quality and quantity of the work done, and he exerts a control over the speed boss as well as the men.

In such works where functions and duties may be different, scientific management provides for the necessary functional specialists to deal with them. In the system of scientific management, specialization provides a clean-cut division of duties and responsibilities which gives no chance either for overlapping authorities or for errors of omission.

In the case of getting the maximum out of the men, scientific management applies its fundamental principle of carefully fitting the man to the job and the job to the man. Once this is done by systematic training, it pays the worker, not as little as he will work for, but as much as management can afford. It improves working conditions because increased efficiency can only be obtained by doing so. Reduced to essentials, the worker devotes his entire time and energy to the work of producing in the most healthful environment, the planning department finds and plans the details of the "best way," and the foreman exerts executive authority in the single field in which he specializes.

Scientific control of materials implies a strict accounting for every scrap of material used, and no material may be issued from the stores except on duly authorized requisitions. Everything issued must be charged to the specific job or expense for which it is required, so that every particle of material that passes from the control of the stores appears in the costs, leaving no consumption unaccounted for when yearly stock-taking occurs. The storekeeper carries the responsibility for all stores under his control.

The fixing of maximum and minimum limits prevents over-stocking or shortages taking place. The system of card records of receipts and disbursements of materials, and the systematic checking up of balances, makes an annual stock-taking practically unnecessary. Proper specifications, and a system of inspecting incoming materials to see that they conform to these specifications, the provision and careful supervision of stock-on-hand limits, and methodical ways of checking weights and numbers virtually reduce store-keeping to a fool-proof and automatic routine.

Getting the maximum out of machines does not imply using machines instead of hands, where possible. It simply means getting the maximum return out of the capital represented by the machines. This ideal managing of machine operations entails the following requirements—[1]

1. The correct volume of work.

2. The correct handling equipment to ensure that the work flows to the machine at exactly the same rate as the machine can deal with it at its maximum output, and that the finished work leaves as promptly.

3. The correct degree of maintenance to ensure that no machine will break down.

4. The correct handling equipment on the machine itself to ensure that jobs are set up on and taken down from the machine most expeditiously.

5. The correct illumination for maximum efficiency.

6. The cutting edges of tools, etc., to be kept sharp by an agency other than the machinist.

7. The work to be given only to the machine adapted for it and the machine to be fed at maximum capacity at all times.

8. For each machine records are to be kept as to its performance, output, repair costs, power consumption, and so on, in order that the cost of each operation is known

[1] H. F. Porter, *Library of Business Practice*, p. 13.

precisely and also the efficiency of each unit as a profit-earning producer.

Labour Opposition to Principles of Scientific Management in British Industries

On the whole the Taylorian theory of scientific management, in its original sense, has made very little headway in British industry on account of the opposition of organized labour and a lack of standardization in industry, as well as an apparent apathy in some managements towards changing from traditional methods of organization. Extravagant claims were made, and those industries which first adopted the Taylor System were disappointed in the actual results. The opposition of labour had its foundation in that reputation of Taylorism for neglecting the human element in industry, and for its tendency to penalize the slow worker by over-driving.

The wide development following the adoption of Taylor's principles in the U.S.A. was specially favoured by a rapid industrial expansion with a relative shortage of labour. In America labour is not so highly organized as in Britain, while American industries suffer severely from a shifting labour force. American industrialists were, to a great extent, forced to employ some form of scientific management to cut down labour turnover and to lessen production costs.

While representative American labour has, within recent years, lost much of its former antagonism towards the principles of scientific management (due chiefly to a wider outlook on the part of the individual worker), the situation with regard to British organized labour is fundamentally different. The earlier expositions of scientific management were misunderstood, and its principles violently opposed by British trade unions on account of several important considerations. These are briefly—

1. The fact that Taylor had made it clear that he never considered the workers as a body which possessed traditional rights and privileges.

2. Workers trained as individuals for specialized operations would fail to appreciate the advantages of labour organizations.

3. As regards methods of work and remuneration the management became an industrial autocracy, paying no regard whatever to the claims of trade unionists.

Professor Shields states that further objections against the scientific augmentation of production included charges of ignoring the character, welfare, and rights of individual workers, and of gaining the desired results with cunningly devised sweating. It was charged also with the elimination of skilled craftsmanship, with reducing the field for competitive work, and with giving the employers information regarding methods, premium, and bonus rates and even wage rates, which eventually would be used to the detriment of labour.[1]

From the individual worker's view-point Dr. Taylor's proposal to carry his theories to the extent of functionalizing the foreman carried a lot of weight in establishing an instinctive opposition to anything approaching the new technique in management. The traditional distrust of the skilled craftsman to both pure and applied technology has a long history. Even in the present-day engineering shops where the proportion of skilled craftsmen is relatively high, the feeling that the journeyman knows his particular job better than the management is quite apparent. The old hands distrust theorizing and implant as far as possible a scorn of it in the minds of the younger journeymen and apprentices.

On the other hand, in the matter of executive direction the average journeyman looks to his leading hand or to the foreman for immediate instructions. In his mind one person, either foreman or leading hand, represents the company or the industry for which he works. Hence, to introduce a system of functionalized foremen would mean that the worker in this country would suddenly be asked

[1] B. F. Shields, *The Evolution of Industrial Organization.*

to submit to the instructions of a multiplicity of supervisors. The difficulty in applying a complete functional system, either drastically or by adaptation, will lie with the problem of the foreman.

The Foreman

In most shops the foreman is directly responsible to the works manager for the engagement and dismissal of all workers in his charge. He is responsible for the work they do and consequently he is given unquestioned control over his men. If a system is suddenly introduced through which a foreman has to report misbehaviour to a higher authority, instead of dismissing summarily the offender, works discipline suffers; or, if having ordered the worker's discharge, the works manager vetoes his orders, a dangerous source of work restriction may arise. Workmen, on the whole, look to the foreman as the ultimate power, " and if they can hold their jobs without the necessity of always pleasing him respect for him vanishes."

The ideal foreman is difficult to obtain; and where the foreman may be, as at present, technically competent, he usually falls short in managerial capacity. Foremen are chosen in most works because of their superior knowledge of the job. As matters are to-day, foremen know much more about the machines and processes than about management of men. Their function, on being made foreman, is changed fundamentally. They are charged with the management of men with whom they are in immediate and intimate contact—a more difficult task than that of the manager who exercises a more or less remote control.

His empirical technical knowledge will not assist him in his true function as a leader of men. Almost all other aspects of managerial control, planning, designing, production, inspection, and so on, are now exercised under specialist control. The carrying out of control on functional lines to the extent of having specialist foremen would appear too drastic when the nature and conditions of most

British industrial undertakings, as well as the type of organized worker in them, is considered. Mr. Lee suggests that there is much ground for asserting that a fundamental difficulty to be faced at present lies with the foreman. If the principles of scientific management are to be introduced to that extent into British industry, the foreman must first be considered, and some scheme outlined whereby he may be given a wider and more administrative outlook before control is placed in his hands.[1]

The question of choice and training of foremen is one of much complexity. Some works make it a rule never to promote a foreman over those men with whom he formerly worked and associated himself. The comparative failure of scientific management in many works has frequently been attributed to the choice and training of the functional foreman. If the workers' immediate contact with executive control is subjected to friction of any kind, great difficulty will be experienced in carrying out the plans of the management.

The foreman has a key-position in an industrial organization. He is responsible for maintaining production of the specified quality at the required rate and at the minimum cost from his section. Co-ordination in the shops and a knowledge of the relative importance of all current factors of efficient production become his chief care. This responsibility will vary according to the nature of the particular industry. Repetition work, general or mass production, will demand certain types of foremen; but where there is no possibility of repetition in the manufacture of the product the significance of efficient foremanship becomes totally different.

In the latter case good foremanship entails, first, the ability to keep a continuous personal supervision over materials. As the amount of planning beforehand must of necessity be inadequate, the extent of the trust which has to be placed in the skill and judgment of individual workers

[1] J. Lee, *Industrial Administration.*

rests entirely with the foreman. He must possess technical knowledge, as well as craft skill and all-round experience, in a sufficient degree to enable him to instruct individual workers where necessary as to the different operations in the order of production. Ultimately, the cost of production is affected, beneficially or otherwise, by the efficiency of the foreman.

In contrast to jobbing production, mass production calls for foremanship of a different order. Here he follows out strictly a pre-planned series of instructions. In the sequence of production through his particular section he makes certain observations and records, and from these furnishes prompt and accurate reports to his superiors. Initiative action is, as a general rule, outside the scope of his responsibility, but individual judgment is exercised regarding the necessity of checking or referring back if the orders issued may seem to clash with some circumstance unforeseen by the planning department. The foreman's chief function is to lead and inspire the men in order to obtain that necessary individual enthusiasm which in itself assists and maintains departmental efficiency.

Mixed production may incorporate jobbing production along with repetition work in the manufacture of a range of similar articles, or where there is the possibility of producing allied products by similar processes. Active co-operation with those officers immediately above him must be the foreman's chief aim. The foreman will be responsible for the maintenance of the actual manufacturing costs in his section at as low a level as possible; this will include wages and power charges. His value will be measured by his ability to devise special emergency arrangements and his power of control over workers on whom little reliance can be placed as regards skill and experience.

In general, the foreman's responsibility to the management is the ultimate responsibility in the shops, or on the machines, of securing the determined amount of production of standard quality and at the minimum cost. He is the

interpreter of the company's policy to the rank and file of the workers; and the development of the workers' interest in the work and the promotion of satisfaction in the job is a prime responsibility of the foreman.

The Works Manager

The works manager is the focal point of the managerial activities extending throughout the works. In an average works the works manager will make provision for the efficient functioning of the following activities: purchasing, internal transport, stores, employment, supervision, maintenance of plant and buildings, planning, time study and rate fixing, inspection, administration records, and research.

Only where the works is very small will he directly control these activities in person; otherwise, he will delegate the control to special individuals and departments. In either large or small plants the works manager has a function so important that it must never be hampered by interference. Even suggestions for improvement from the technical staff should not be adopted in the face of his judgment against them.

The works manager must have the essential qualifications pertaining to the technique of production; he must be a highly-trained technical man. This, however, is not sufficient in itself; combined with sound technical knowledge he must possess qualities of an outstanding character—the art of individual leadership, the ability to inspire subordinates with enthusiasm, and the knack of being able to display initiative. He must be broad-minded; he must be able to recognize the type of mind which is basically analytical and that which is basically empirical and dominating, and he must be able to distinguish between the widly inaccurate yet ingenious mind and the meticulously accurate yet dull mind if he is to ensure that the members of his staff are to be employed on the work for which they are individually best fitted. He must be capable of obtaining full co-operation and co-ordination of effort, and allow

of no over-riding or interference by higher officials with departmental functions.

Industrial Psychology

Modern management, successfully applied under scientific principles, is dependent greatly upon a scientific knowledge of human nature. Industrial psychologists and organized bodies, such as the National Institute of Industrial Psychology and the Industrial Health Research Board, are trying to render assistance by investigating the phenomena of monotony and fatigue and correlating the capabilities of the worker and the qualities which the job requires. The success of the work already done "has demonstrated the value of submitting to the trained psychologist problems in connection with heating, lighting, ventilation, movement-study, and other factors influencing the well-being of the workers, such as the removal of mental strain and irritation. It is essential to ascertain and ensure that the working methods employed in a factory are sound from the physiological and psychological standpoint." [1]

Both men and machines are managed in industry, but men alone can react to any given form of management, and their reactions are a fundamental factor in every industrial situation. That men react to the treatment they receive must be recognized as the essential point in attaining the effective co-operation and team work which controls efficient production. This point is strongly emphasized by prominent industrial authorities in America who have "clearly demonstrated the necessity of effective morale to achieve anywhere near optimum production." [2]

"Most employers and persons in managerial positions are all too ignorant of the real attitudes of their employees towards the various factors in their working life. . . . On the contrary, most managers' and employers' views are based on what they *think* is the case or what they wish

were the case, rather than what they *know* to be the situation. . . . And the employer will continue to be at a loss to understand why his employees act as they do until he has, not only the information, but the experience and background which will permit him to see the situation from the point of view of his employees." [1]

One of industry's greatest losses of efficiency is caused by the labour policy of "ca' canny." In many cases its adoption is due to an attitude—justified or not—of resentment, or fear of exploitation on the part of the worker. All bonus or incentive systems for the development of labour efficiency fail if the worker acts on the belief that he is being exploited by restricting output in an organized and effective way.

Psychological research has done much to develop methods for determining the sources of these attitudes and towards establishing a technique for measuring "accurately in a quantitative manner the attitude of labour towards working conditions, towards management," and other factors.

One factor which is very important in determining a worker's attitude to his work is the treatment he receives from his leading hand or foreman. The root causes of unsatisfactory work lie, in most cases, in the industrial atmosphere itself, but frequently there are fundamental causes arising from conditions outside the works or due to interactions between his home life and his working life. Domestic troubles will reflect themselves in an employee's productive capacity.

"Psychology can contribute to industrial efficiency by providing management with the resources which will enable it to build the morale and co-operation necessary for efficient production." Two examples of the work done in this respect by the National Institute of Industrial Psychology will be illuminative.

"The spinning department of a certain mill had a very high labour turnover, and the workers were found to indulge in a good deal of pessimistic day-dreaming. Almost every worker was found to suffer from foot trouble, and

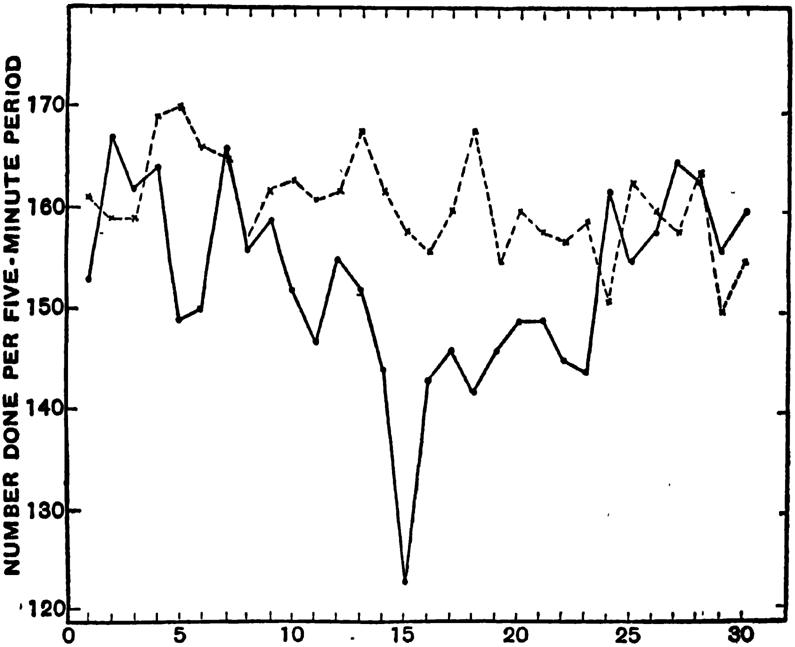


FIG. 28

some claimed that they had neuritis in their arms, shoulders, or legs.

"Two or three ten-minute rest periods were introduced in the morning and again in the afternoon, and the workers were instructed in the best methods of muscular relaxation. The morale improved almost at once, the men being pleased and interested, and the spinners who had never earned a bonus previously began to make bonuses in addition to their wages."[1]

[1] H. J. Welch and G. Miles, *Industrial Psychology in Practice*, p. 21.

In another factory boredom was found to cause a slower and more varied rate of working among workers engaged on repetitive tasks. Fig. 28 shows the rate of working when (*a*) boredom was prominent and mind-wandering almost absent (*continuous line*), and (*b*) boredom was slight and mind-wandering prominent (*broken line*).[1]

Management should take every opportunity to discover and utilize intelligently the various forces which influence the lives of their employees. Where the works is small the employer or the manager himself, if he understands and can apply the modern use of psychology, will be able to secure a valuable industrial asset in the whole-hearted loyalty of his employees. In large organizations it will be necessary to establish an adequate and trained personnel department with a capable research division in social and clinical psychology and related sciences.

[1] H. J. Welch and G. Miles, *Industrial Psychology in Practice*, p. 34.

CHAPTER XIII

WAGES AND EFFICIENCY

The Problem of Wages

Prior to the war the adjustment of wage rates to economic changes was a gradual process, and consequently wages had acquired a high degree of stability. The relations between wages in allied occupations or between industry and industry were also stable. We are justified in saying that the pre-war wages consisted of a *system* in which there was a close connection between different rates. The pre-war problem of wages, therefore, dealt with particular rates for particular jobs, and was settled by reference to the normal ratio between that rate and others. An alteration in the value of money might indeed lead to wholesale changes in rates, but such changes were more or less uniform. The war dislocated this system and destroyed its stability. Where previously the general question as to what constitutes a fair wage would not arise, since the war it has been necessary to consider absolute levels of wages instead of merely adjusting the levels in the system. The rise in the cost of living, the high earnings of munition workers, the large profits in this and other industries, the losses in some branches of industry, dilution of labour and governmental control, all operated to produce an extensive dislocation of relative wage rates. During the war period the ordinary commercial basis of employment disappeared and modifications took place in wage standards justified by war conditions, but involving no relation to industrial conditions in time of peace. The adjustment of wages by national awards levelled up the wages in each occupation. Since, in many cases, the local variations which were thus removed were due to more or less permanent economic differences, this levelling-up process forced wages out of relation to normal commercial conditions.

In the post-war settlement of industrial conditions industry was faced with the problem of restoring stability to the wages system. In order to do this it was necessary to seek some basis from which to calculate the variations in rates due to changes and modifications in the industrial and economic system.

A system of wages adjusted on a cost-of-living basis is not consistent with true economic principles. The classification of the people into groups and the presumptive right of one set of wage-earners to a higher standard of living than another based on this classification cannot be defended. It is true that wages cannot sink below the subsistence level. The efficiency level of wages is above the poverty line, and no wage should sink below the efficiency level. But a cost-of-living basis for wages neglects the changes which alter the relative productivity of different trades. An increase in relative productivity should result in an increased wage, which on the cost-of-living basis the workers will not receive. A decrease in relative productivity, with a wage fixed on this basis, will result in unemployment.

The true problem of wages in industry is to find the level of remuneration which, while affording capital and enterprise sufficient interest and profits, will at the same time offer to labour an incentive sufficient to secure the highest productive efficiency. If there is any surplus left when these claims have been satisfied it will go to the entrepreneur; until competition between entrepreneurs by lowering prices will hand over the surplus to the consumers, who in the main are the workers themselves.

Unfortunately, there is no abstract principle, no economic law, no logical process by which these workable wage levels can be determined. Nor is there even a fixed relation between wages and profits. In a society organized under the principle of free competition experiments with supply and demand form the only original source of information. Wages are the incentive to work, and must be

sufficient to produce a sufficient supply of labour of the quality required. If the work is to be adequate the incentive must be adequate. On the other hand, the margin left for the remuneration of capital and enterprise must not be so low as to occasion any decrease in the supply of those factors. To arrive at an equitable division would require a knowledge of the relative values of a unit of nervous and muscular energy expended in labour, a unit of nervous energy and brain-power involved in management, and a unit of abstinence and strain involved in saving and risking capital.

From the investment point of view, capital is homogeneous and its value is determined by supply and demand. But labour is not in any sense homogeneous. The labour capacity offered by a worker is just as uncertain a quantity as the nature and conditions of the task presented by the employer. The performance of an operation in one works is essentially different from the performance of the same operation in another works. The machinery may be modern or antiquated, the service aids may be good or bad; the speed and stress varies enormously, the environment may be healthy, the works may be well ventilated and comfortable or the reverse. In the case of the worker his age and past experience can usually be ascertained. His constitutional vigour and state of health may be determined by medical examination. But as to his regularity and dependability, accuracy and dexterity, speed and stamina, mental alertness, intelligence and education, there is little knowledge. As a result of so many indeterminate factors neither party in a wage contract can feel certain that the bargain is fair and just, so suspicion and distrust give additional complexity to the problem of wage determination.

Efficiency of Labour

In any particular grade labour is measured by its productivity. Productivity is measured by the value of what

is produced. It is evident then that the value of labour as an instrument of production depends largely on its efficiency. The economic value of labour in manufacture depends particularly on strength and endurance, on health, speed, intelligence and resourcefulness, powers of concentration and perseverance, trustworthiness, and adaptability. Each of these plays a part in determining the efficiency of the individual worker. There may be a considerable demand for labour while at the same time there are many people unemployed. The demand is not merely for *labour*, but for labour of a particular kind—trained, intelligent, and efficient. We may notice especially the following factors which have a strong bearing on the efficiency of labour in any particular community—

(a) **Climate.** In general, the industrial and commercial races of the world are situated in the temperate regions, and this is mainly because of the influence which climate has on the character of the inhabitants. A cool bracing climate is invigorating; consequently residents in the temperate regions are for the most part energetic and hard-working, and have the power of continued application of labour. The tropical regions, on the other hand, are enervating. Climate exercises an influence on human activities which can definitely be measured. A series of experiments[1] carried out in various parts of the world shows conclusively that human activity, both mental and physical, varies with the seasons, and is at a maximum in spring and autumn. A climate which has enough contrast of seasons to be stimulating, but not enough to create nervous tension, is best for industrial purposes.

(b) **Racial Peculiarities.** Through a process of evolution nations tend to develop special characteristics, and this factor has had an important influence on the geographical division of labour. Certain nations have shown themselves peculiarly adapted for particular kinds of work. The German attention to detail gave them the lead in the

[1] *Cf.* Huntingdon, *Civilization and Climate.*

manufacture of scientific instruments; the artistic character of the French is reflected in many of their productions; while the heavy solid English character is shown in the reliable and durable character of our goods. In a report on factory labour in India, issued in 1907, the efficiency of Indian and British labour is compared. The former was stated to be lacking in continuous application, punctuality, energy, and regularity. It was not specialized, so that the workers were sometimes engaged in the factory and sometimes in agriculture. Owing to want of skill and education the Indian workers were wasteful, and through want of care and cleanliness damage to machinery was frequent. The Indian worker did not seem to desire to increase his skill or to work up to his full capacity. These differences may in part have arisen from climatic causes, but in India itself the hereditary characteristics of the different races are strongly marked.

(c) **Standard of Living.** In labour, as in production generally, there is a point of maximum efficiency. A worker who is underfed cannot do good work. Wages which provide merely for the bare necessaries of life are not sufficient to provide for the necessaries of efficiency. A rate of wages which is so low that it does not permit the worker to develop his greatest strength and skill is injurious not only to the worker but to society. Workers that are underfed cannot be efficient. They are thus prevented from living a vigorous and reasonable life, while at the same time their want of efficiency reduces their production and consequently reduces the profits of the employer.

(d) **Sanitary Conditions.** The conditions under which work is carried out have a considerable influence on the amount produced. Bad ventilation, polluted air, and insanitary surroundings breed listlessness, if not actual disease. By devitalizing the labourer in physique and lowering his vitality, unhealthy working conditions lower the labourer's productive efficiency. The influence of such conditions on the health of the community are recognized

in most civilized states, where factory laws, to some extent, regulate the conditions under which work is carried on. But since the worker does not spend all his life in the workshop or factory, the housing of the workers under sanitary conditions in healthful surroundings is a factor of primary importance.

(e) **General Intelligence.** Efficiency generally increases directly with the intelligence of the workers. The greater the standard of intelligence of the workers the less difficult will be their instruction in efficient methods. The intelligent worker is more careful of material and is less likely to waste time. He requires less supervision, and thus reduces the cost of superintendence. He is more careful in his work and in this way lessens the likelihood of damage to delicate and intricate machinery.

(f) **General and Technical Education.** To attain the highest stage of productivity a country must develop all the powers latent in its population. In order that the potential ability of each child may be discovered, and that the capacity of each individual may be trained to its highest point, an effective educational system is necessary. General education, though it promotes industrial efficiency, is not undertaken primarily for that purpose. On the other hand, technical, industrial, and commercial education are undertaken primarily for the sake of their influence on production. Where such education is carried out at the expense of the worker himself the cost may be regarded as capital expended in making him a more effective instrument of production. Where a scheme of technical education is carried out by an employer the cost is a part of his expenses of production. But, in general, neither of these ways has proved efficient, and specialized education of this type is now regarded as a function of the State.

(g) **Moral Causes.** The general outlook of the worker influences his productive efficiency. The ambitious worker without prospect of promotion loses spirit. Hopelessness may reduce the efficient workers to the level of the less

efficient. It is for this reason that slave labour is markedly inefficient. "Productive efficiency is greatly increased by the cheerfulness and hopefulness in labour, growing out of self-respect and social ambition and the labourer's personal interest in the result of his work." [1]

TIME-WAGE SYSTEM

From the consideration of the various factors which influence efficiency it is obvious that the standard of efficiency varies with different individuals and under varying conditions. Differentiation in wage payment is, therefore, absolutely necessary in order to secure efficiency. The incentive must be adjusted to the individual. This is one of the main objections to the payment of wages on a time basis.

In principle the time-wage system pays for time worked at a fixed rate per hour; the question of the work done during the time paid for depends directly on one hand upon the degree of supervision or the discipline exercised, and upon the goodwill on the other. Where the work itself is of a monotonous nature personal enthusiasm vanishes; and for a return in output for the wages paid disciplinary measures, driving and irksome, must be applied constantly in all parts of the works.

If the workmen cannot be persuaded to feel that his interests are identical with those of the enterprise profits will not, as a rule, increase through any extra expenditure of energy on his part. He knows exactly how little he may exert himself without incurring the danger of being discharged. A mediocre day's work will bring him his wages; and the wages, he considers in turn, are small enough for that. In all large works the time-wage system, in spite of discipline, breeds "soldiering." "Soldiering" is a case of making believe that work is being done when it is not. Furthermore, "soldiering" is anything but a restful habit for the workers themselves. It often makes men work

[1] F. Walker, *Wages Questions*, p. 72.

much harder pretending to work, and avoiding supervisory attention being drawn to them, than in actually producing output.

If the rate paid is a "fair" wage the average man is paid according to his work, the men below the average are overpaid, while the men above the average are underpaid. This system, therefore, tends to repress the superior men and inevitably breeds discontent among them. It is demoralizing and levelling. The best men realize that there is no profit to them in working hard, so their output decreases and they sink to the level of the inferior workers. For the lower forms of manual labour this system of wage payment may be as satisfactory as any, but the more highly skilled the task is, the less satisfactory becomes the time system of wage payment. The exceptional man justly resents this system. It is upheld by the trade unions because it produces solidarity; it is desired by shirkers who do not wish to have their wages measured by their work, and it is favoured by many employers because it simplifies the calculation of wages.

The time-wage system is, in itself, one of the causes of the accentuated sense of monotony in work where there is no intrinsic interest apparent in the daily task. A feature of time-wage payment is that of extra rates for hours worked in excess of a normal working day. The usual increase in rate, as agreed upon between the engineering employers federations and trade unions in England, is an additional quarter rate for the first two hours after a full day has been worked, and time and a half for any hours worked afterwards. Special rates apply to week-ends and night-shifts.

Piece-work

The simplest form of payment on results is the piece-work system. It is as old as, if not older in some respects than, the time-wage system; but it has been rendered less a source of evil by the guarantee of special time wages as a

minimum. In essentials it is a definite price per piece, and the wages amount to the product of the price per piece and the number of pieces completed in a working week. Where the time wage is guaranteed, either full or partial time rate, irrespective of the work produced, the difference between the total piece-work earnings and the guaranteed minimum wage is known as the piece-work bonus or piece-work balance.

Under the piece-work system the workers are paid according to the value of their work. The chief advantage of this system is that a market is given to the reserve productive power of those persons who are capable of doing better than the average performance. Piece rates attract ambitious workers and those who are dissatisfied with existing conditions and who wish to use their energies to raise themselves into a higher economic class. It has been objected that if the earnings of the workers become too high the employers cut the rates, and in many cases a standard day's output has been adopted by the workers in order to avoid such cuts. With the improvements of production methods and processes and with the introduction of new specialized machinery a piece rate must sooner or later become obsolete and require revision. But a piece rate once fixed should be cut only when improvements of method or machinery have altered the character of the task.

It must be noted that piece rates may, and often do, inflict injustice in respect of earnings. If in a factory the appliances are not equally good, if the machines are not of the same type or do not work at the same speed, if the material worked on is not uniform in quality, if, in short, the conditions are not standardized, piece-work wages give results which are disproportionate to the efficiency of the workers.

In many industries the rates are settled by collective bargaining between the employers' association and the trade union concerned. The trade boards control the piece rates for unorganized trades. An important point becomes

evident in rate setting; if piece rates do not normally yield more than time rates they lose their value as incentive. There must be a guarantee also that the worker will not lose if the output is reduced through circumstances over which he has no control. Hence, the trade boards and most trade-union agreements stipulate for the payment of time rates as the minimum remuneration where piece rates obtain. Generally, the piece-work basis is set from 15 to 20 per cent above the minimum time rates. Whitley Councils arrange for at least 25 per cent above time rates. Engineering and similar trades have many agreements whereby a worker of average ability is enabled to earn at least 30 per cent above time rates [1]

Minimum rates of wages are defined by trade boards. These boards do not as a rule function in areas where trade-union organization is strongly felt, but they will act in such industrial areas where the average wage rate is unreasonably low.

The primary function of the trade board set up in any industry is to define minimum wage rates, and also the minimum piece rates, for normally efficient workers. Other objects of the trade board include the protection of poorly organized workers, and the prevention of trade disputes.

Disadvantages of Piece-rate System

There is always much difficulty in establishing a piece rate based on a "fair" output, since any attempt to replace time wages by piece rates often leads to a difference of opinion between the workers and the management on the question of what constitutes a normal output. If the initial piece rate is set excessively costs of production remain high, and if it is cut the workers retaliate by restricting output to prevent another cut. The reputation of the management for just dealing suffers, while any advantages gained in reduced cost of production are negligible.

[1] C. H. Northcott, *The Principles and Practice of Industrial Relations*, p. 125.

It is difficult also to adjust equitably the earnings of the workers to meet contingencies such as a breakdown of plant, failure of power, and so on, outside the workers' control. Any improvements in plant or the installation of modern machines to increase output tends to increase the individual earnings of piece-workers while penalizing to some extent the employer who supplies the necessary capital.

Dissatisfaction becomes apparent in the works if there is considerable diversity between the earnings of the piece-workers and those of their foremen and leading hands. The significance of craftsmanship is greatly reduced, and where delicate machinery or valuable raw material is involved, waste resulting from speed of operation and insufficient supervision more than offsets the gain in extra output. An elaborate system of inspection simply aggravates the state of affairs.

Dr. Northcott says that under ideal conditions the piece-rate system is equitable and economical. It is the most satisfactory form of financial incentive, since increased energy is suitably rewarded. Workers on piece rate are, to a great extent, their own supervisors, and hence the system becomes relatively less costly than the time-wage system. The increased output tends to render the overhead charges proportionately easier to carry. Also the production cost per unit product is reduced considerably.[1]

Sliding Scale

A sliding scale is a piece-rate plan of wage payment under which wages are so adjusted that they rise and fall with the selling price of the materials worked on. This usually (though not necessarily) means that wages vary with profits, and the result is a crude sort of profit sharing and loss sharing. This system was formerly much more prevalent than at present, though it is still found in some branches of the iron and steel trade. It has the advantage that wage disputes are obviated during fixed periods, and

[1] C. H. Northcott, *ibid.*

that it causes alterations in wage rates to take place gradually. But against this the system has the grave disadvantage that a speculative element is introduced into wages by linking them with the rise and fall of a commodity's price. Further, the range of applicability of sliding scales is narrow. Wages often increase while the selling price of the product falls. Increased efficiency in motor-car production, for example, may result in higher wages, while at the same time cars can be sold at a lower price. In an industry subject to increasing returns, and for whose products there is an elastic demand, a sliding scale would prove unworkable.

From every aspect any system of payment by result stands supreme among wage systems, as in principle it satisfies the inherent sense of justice in the worker. The appeal is psychological. Greater financial reward for the proportionate expenditure of energy affects and also satisfies the human instincts of acquisition, self-expression, and self-realization. From the many forms of "payment by result" systems, suitable for varying conditions and different industries, it only remains to decide which particular form is best suited for the specific purpose in view.

Payment by Result Systems

The three systems, time-wage, piece-rate, and sliding-scale, may be called the "older" systems, to distinguish them from the newer systems, which are extremely varied. These may be divided into—

(*a*) Those systems which leave previous conditions of management and operation undisturbed.

(*b*) Those which require highly standardized equipment and conditions and accurate time setting.

Of the former class the "Halsey" and "Rowan" premium systems are the best known. The systems are similar in that the standard time set for each job is based on previous experience.

Both systems guarantee day wages, so that if a worker

exceeds the standard time he still gets the standard hourly rate for the time worked. Where the task is performed in less than the standard time a bonus is paid in addition to the standard rate, and it is in the method of calculation of this bonus that the two systems differ.

Halsey System. The first category may be now considered. Mr. F. A. Halsey is the originator of what is known as the Halsey premium system. Under this plan the method of payment is approached from the point of view of time saved on a job. If the worker finishes a task in less than the allotted time he receives, in addition to the hourly rate for the time worked, a proportion of the wages of the time saved. Under the Halsey-Weir modification of this system the extra proportion is one-half. Under the original Halsey system the fraction is constant, but is set from one-quarter to one-half according to the nature of the task.

For example—

Let x hours be allotted to a particular task.
Let y hours be the time a workman takes to do it.
Let B be the amount of bonus in time.

$$\begin{aligned} \text{Then } B &= \tfrac{1}{3}[1]\,(x-y) \quad . \quad . \quad \text{Halsey} \\ &= \tfrac{1}{2}\,(x-y) \quad . \quad . \quad \text{Halsey-Weir} \end{aligned}$$

and if the standard wage rate is S per hour the workman receives

$$\begin{aligned} &Sy + \tfrac{1}{3}S(x-y) \quad . \quad . \quad . \quad \text{Halsey} \\ \text{and } &Sy + \tfrac{1}{2}S(x-y) \quad . \quad . \quad . \quad \text{Halsey-Weir} \end{aligned}$$

Rowan System. If instead of having the premium a constant fraction of the time saved it is a fraction equivalent to the time saved over the allotted time, the system then becomes what is known as the Rowan system. Devised by Mr. James Rowan of David Rowan & Sons, Glasgow, it may be considered a modified form of the Halsey system. Where it is difficult to set accurate standard times the Rowan system is preferable. Excessive amounts in bonuses

[1] $\frac{1}{3}$ taken as a fractional value between $\frac{1}{4}$ and $\frac{1}{2}$.

cannot be earned, since when half the time is saved the bonus is a maximum, afterwards decreasing.

For example, using the same notation as above—

$$\text{The bonus } B = \frac{(x-y)}{x}(y) \text{ in time}$$

$$\text{and in money } B = \frac{(x-y)}{x} Sy.$$

Taking the three systems mentioned, the piece-rate, the Halsey-Weir, and the Rowan, it will be possible to compare by means of the accompanying graphs the differences as regards bonus, rates, and total labour costs.

Let S, the standard hourly rate, be one shilling and sixpence.

Let the allotted time x be 8 hours.

X	8	8	8	8	8	8	8	8
Y	8	7	6	5	4	3	2	1
$X - Y$	0	1	2	3	4	5	6	7
Output in 8 hours . .	1	$1\frac{1}{7}$	$1\frac{1}{3}$	$1\frac{3}{5}$	2	$2\frac{2}{3}$	4	8
Hourly bonus, piece rate .	0	1	2	3	4	5	6	7
Hourly bonus, Halsey-Weir	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$
Hourly bonus, Rowan .	0	·875	1·5	1·875	2	1·875	1·5	·875

HOURLY WAGES IN SHILLINGS

Piece rate . .	1·5	1·7	2·0	2·4	3·0	4·0	6·0	12·0
Halsey-Weir .	1·5	1·6	1·75	1·95	2·25	2·75	3·75	6·75
Rowan . .	1·5	1·68	1·87	2·06	2·25	2·4	2·6	2·8

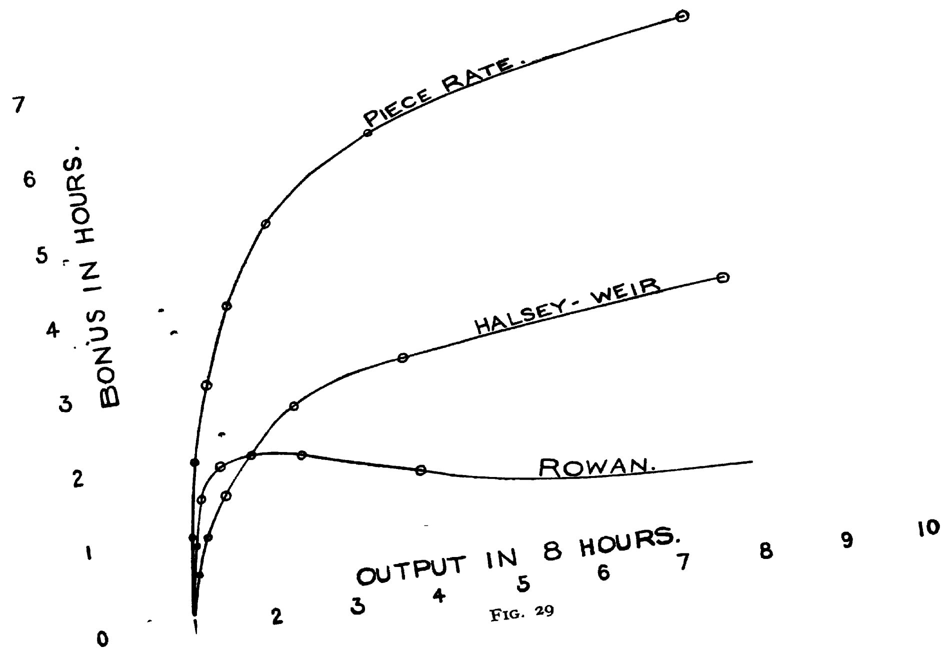

PIECE RATE.
HALSEY-WEIR
ROWAN.
BONUS IN HOURS.
OUTPUT IN 8 HOURS.
0
1
2
3
4
5
6
7
8
9
10

FIG. 29

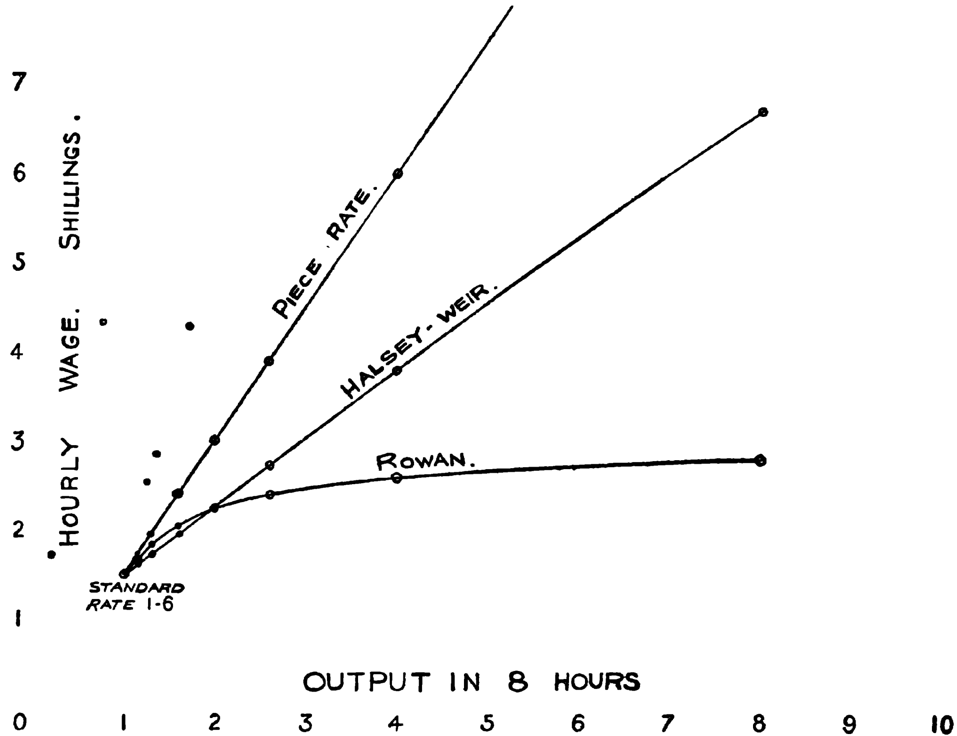

HOURLY WAGE. SHILLINGS.
7
6
5
4
3
2
1
0
1
2
3
4
5
6
7
8
9
10
PIECE RATE.
HALSEY-WEIR.
ROWAN.
STANDARD
RATE 1-6
OUTPUT IN 8 HOURS

FIG. 30

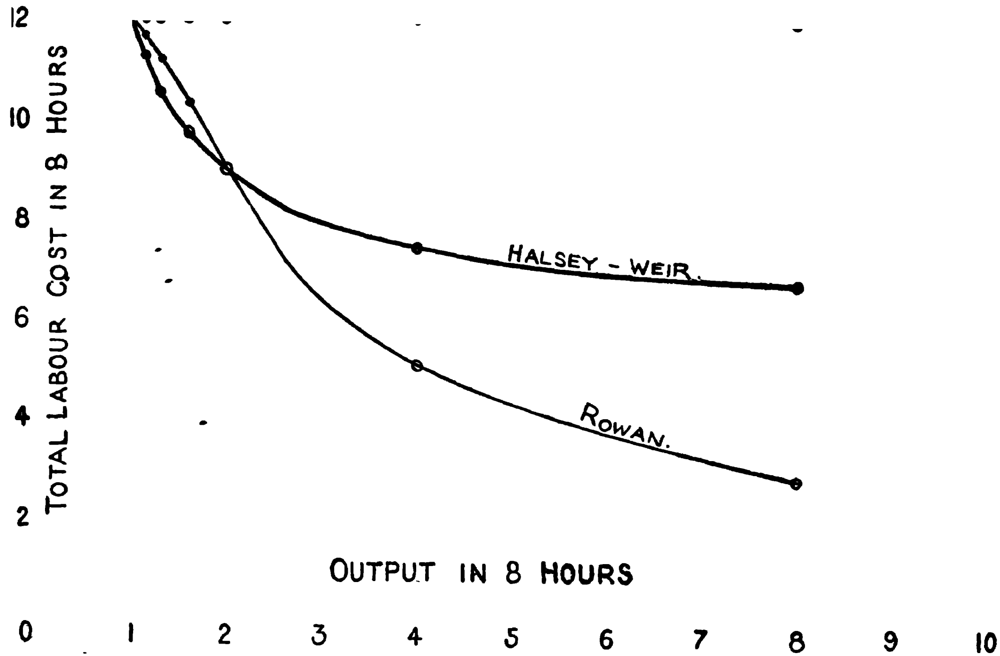

12
10
8
6
4
2
TOTAL LABOUR COST IN 8 HOURS
HALSEY - WEIR.
ROWAN.
OUTPUT IN 8 HOURS
0
1
2
3
4
5
6
7
8
9
10

FIG. 31

TOTAL LABOUR COST, SHILLINGS

Piece rate . .	12	12	12	12	12	12	12	12
Halsey-Weir .	12	11·2	10·5	9·75	9·00	8·25	7·5	6·75
Rowan . .	12	11·76	11·22	10·3	9·00	7·2	5·25	2·8

Santa Fé System. Another premium bonus system, used in the United States, is called the Santa Fé system from its originators, the Topeka and Santa Fé Railway. It more nearly resembles piece work than either the Halsey or Rowan methods. A standard time for a particular job is carefully estimated. If the work is completed in this time a bonus is awarded. The bonus increases with decreasing time and decreases with increasing time until at some percentage in excess of the standard time it disappears entirely; the worker then receives the minimum guaranteed time wage.

If the work is done in exactly the determined time the bonus is 20 per cent of the time wage. If the work is done before the allotted time elapses the worker receives the extra wage the employer would have paid had the work taken the standard time to complete. If the work takes an excess of the standard time for its accomplishment the time-wage rate is still paid, plus the bonus which, however, decreases rapidly with increasing time until the time limit is reached (excess of 50 per cent of allotted time) when the bonus vanishes. (See Fig. 32.)

METHODS OF REMUNERATION REQUIRING HIGHLY STANDARDIZED EQUIPMENT AND ACCURATE TIMING

The adoption of the system of "scientific management" in America has led to the introduction of several "efficiency" methods of wage payment. Mr. W. C. Redfield[1]

[1] Redfield, *The New Industrial Day*, pp. 176–177.

has thus summarized the chief aims of scientific management—

"Close co-operation and sympathy between the manage-

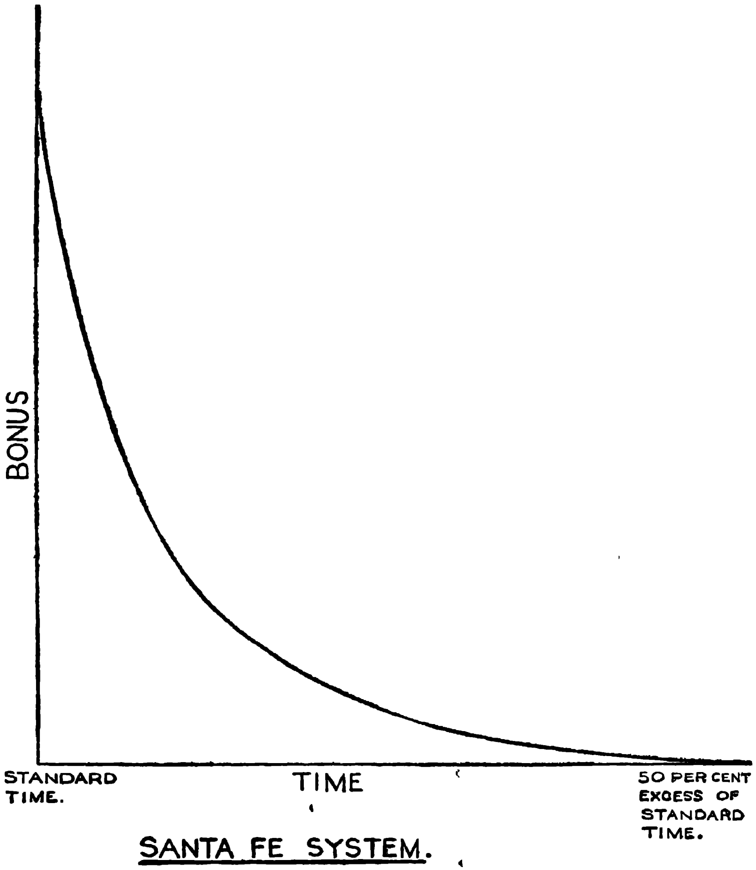


FIG. 32

ment and the workmen. This is foremost and basic. If it is not realized that this is foremost and basic the subject is completely misapprehended.

"The standardization of equipment and accessories throughout the shop.

"The systematizing of work in operation, of the care, maintenance, and issue of materials and tools, and the careful routing of all orders while passing through the works.

"The planning in advance of the work for each machine, and furnishing tools, fixtures, and materials ready to the hand of the workman before needed, so that delays between operations are cut out.

"The study of the actual time occupied by each element or movement of every operation in order to determine the correct time required for it and to save waste energy.

"The determination in time study of the proper allowance for rest, necessary delays, or interruptions of work.

"The fixing of standard time for doing work, based upon the aforesaid studies, and the careful personal instruction of workmen in the best and easiest methods of working.

"The payment usually to the workman of a bonus or premium, based upon his doing the work in a certain relation to the standard time."

The new forms of wage payment under this system aim at—

1. The rigorous control of all equipment and conditions affecting the work.

2. The accurate measurement of a "proper" day's work.

3. A guarantee that a rate shall not be cut unless conditions of production materially alter the nature of the task.

4. Payment according to individual performance.

The systems which come under the above heading are, strictly speaking, purely American, and are applicable, with regard to the attainment of efficient results, only to the highly standardized conditions prevailing in American works. To the British workman they would present a certain amount of difficulty; and industrialists contemplating an installation of any such system would be considerably hampered by the fact that under the Factory

laws, the workmen must be able to calculate their own wages.

In British industry, however, it is possible to combine desirable features from different wage incentive systems, and thus construct a plan to suit the needs and special conditions of the particular works concerned.

Some of the widely-used methods of remuneration for standardized conditions are: the *Taylor Differential Piece rate*, the *Gantt System*, the *Emerson Efficiency Bonus Plan*, the *Parkhurst Differential Bonus Plan*, the *Haynes Manit System*, the *Sherman Individual Group Plan*, the *Bigelow System*, the *Knoeppel*, the *Bedaux System*, the *Wennerlund System*, the *Barth Variable Sharing Plan*, the *Merrick System*, and the *Diemer-Rowan System*.

Taylor Differential Piece-rate Plan. Dr. Taylor, acting on the supposition that the worker has a natural tendency to do as little as possible under a time-wage system, and realizing also the folly of cutting a piece-rate which may have been initially set too high, commenced to make scientific studies of what constitutes the normal day's work for the ordinary workman. In order to provide an incentive for workers to do this normal day's work, he devised what is known as the Differential Piece-rate System. This system involves two distinct piece rates, a high one for workers who accomplish the task set and a low one for those who fail to achieve the standard. Slow and inefficient workers are heavily penalized, since the object of the plan is to retain only first-class workmen on the pay-roll and to eliminate those who cannot reach that standard. The system emphasizes the full and perfect day's work, but it also emphasizes the giving of an adequate training to the workers in the one best way to do that work.

The plan compensates the good worker in a satisfactory manner, with its abnormally high pay for high outputs and abnormally low pay for low outputs. In this way, also, one worker or one gang of workers is not prevented from doing the maximum work possible, independent of the condition

that the workers in the preceding manufacturing sequence achieve their tasks to time. For example, a worker cannot perform a fitting job in specified time unless the different components or materials, tools, and equipment are supplied to him in the correct sequence, at the right time, the right quantity, and the right quality.

While the differential piece rate may be efficient, it would be useless unless the accompanying conditions for its efficiency, including time study, the job itself, provision for adequate inspection, methods, and tools generally, have been made perfect and then standardized. It also requires a very high standard of management and a close co-operation between the management and the workers.

Taylor himself recognized that a word of warning would be necessary in certain respects when he wrote: "When, however, the work is of such variety that each day presents an entirely new task, the pressure of the differential rate is sometimes too severe. The chances of failing to quite reach the task are greater in this class of work than in routine work, and in many cases it is better, owing to the increased difficulties, that the workman should feel sure of at least a regular day's rate, which is secured him by Mr. Gantt's system, in case he falls short of the full task." [1]

Gantt System. Mr. H. L. Gantt invented a system which pays a regular day's wage to every worker, even while he is learning and unable to produce much output, yet at the same time provides for a scientifically determined task, standardized, for which the skilled worker may receive from 30 to 100 per cent extra pay.

This plan eliminated the ill-effects of Taylor's low differential piece rates. At the standardized point in time of the "job performance" the extra pay amounts to 20 per cent of the guaranteed rate. If the standard is improved upon, a percentage allowance based on the time saved is paid to the worker in addition to the higher wages rate. In principle the sharp rise in rates at the standardized

[1] Dr. Taylor, *Shop Management*, p. 78.

point stimulates the workman to accomplish each time the standard set. It is a simple plan, for it ensures that the unskilled or inefficient worker is sure of a full day's money, and yet provides a piece-work incentive for the skilled and efficient. Since, however, the bonus rate is payable on each separate job the worker may speed up on certain jobs to secure the bonus and then "rest" on other jobs for which he receives full day wage rates.

Emerson Bonus Plan. The Emerson Efficiency Bonus Plan follows closely the system invented by Gantt. The efficiency of the worker is estimated by the ratio between the time set and the time he takes. A high standard is set, and for an initial efficiency corresponding to about two-thirds of the standard a bonus is paid which gradually increases, as the worker's efficiency approaches 100 per cent, from 0 to 20 per cent above the guaranteed rate.

Efficiencies of over 100 per cent receive the wages of the time allowed plus a bonus of 20 per cent on the time saved. There is, under this plan, in contrast to both the Taylor and Gantt plans, no unreasonable jump made from under-standard to standard work. The learners, the inefficient, and the less skilled are enabled to participate in small bonuses. Also, the efficiencies are determined over a wage period and the plan may be applied to gangs of men as well as to individuals.

Wages and Efficiency

The system of scientific management has not met with favour in the United Kingdom owing to the lack of standardization in industries. It is doubtful if its application in this country would meet with success. It, however, stresses the importance of managerial efficiency, and if manufacturers and merchants made a careful study of the principles underlying scientific management it would probably result in a process of self-examination which would prove advantageous both to themselves and to the workers.

The efficiency systems of wage payment mentioned are

not applicable to industries generally in this country, as they presuppose highly standardized conditions and equipment. It will be noticed, however, that they all agree in paying men according to individual performance, which is in opposition to the trades-union policy of establishing a single rate for a trade. The policy of the single rate creates a common interest and promotes solidarity of action. But it prevents the introduction of scientific agencies for measuring the value of labour; it opposes the process of specialization, which is an important element of progress, and it denies the principle that each man should be rewarded according to his work, and thereby removes the incentive to the individual to develop his capacity to the utmost.

It must be admitted, however, that an increased efficiency of labour, if confined to only a few branches of industry, may not be unconditionally favourable to the wage-earner. Where, for example, the increase in efficiency fails to bring about an immediate increase of the production, owing to the fear of producers of a serious fall in price, or where increased efficiency leads to over-production in a particular branch of industry, a disturbance of equilibrium of a transient nature will arise which will lead to a decrease in the demand for labour in certain directions.

This holds good only where the increased efficiency applies to a narrow industrial field. The greater the area over which labour acquires the increased efficiency, the smaller is the probability of such temporary disturbances. When the production of goods of all kinds increases, so likewise does the demand for those goods. The farmer who supplies more foodstuffs or the shoemaker who turns out more boots will demand increased supplies of goods of other sorts. Increased efficiency leads to an increase of wealth, which in turn causes an increased demand for goods, and even though this increased demand may operate unequally as respects different classes of goods it cannot be denied that in industry generally an increase in the efficiency of labour must result in the increased welfare of the worker.

In spite of all the evidence which practical experience has given in the support of theory on this point, the workers in this country have as yet failed to grasp its truth. Had they done so there would never have arisen the deplorable policy of "ca' canny." Comparative investigations have shown beyond dispute that wages are highest in those countries where the workers perform the greatest quantity and the best quality of work. The connection between efficiency and wages was recognized in the days of Adam Smith.[1] Brassey, in his *Work and Wages*, published in 1872, illustrates it by many examples[2] drawn from various countries. Since that time much additional proof has been furnished by many different writers.[3]

It must be taken as beyond dispute that wages are influenced by the efficiency of labour. But is the efficiency of labour influenced by wages? In part at any rate it is. Where wages are so low that the worker is underfed and insufficiently clad, an increase of wages up to the point of nourishment adequate for full physical efficiency will beyond doubt increase his value as a worker. It would, therefore, seem as if it would pay the employers to increase the wages of lowly paid workers in order to obtain this additional efficiency, but there are other circumstances which must be taken into account. It requires time to enable full subsistence to bring weakened and demoralized workers into a condition of physical strength and efficiency. Even then it is not always certain that this result will be achieved, because some workers have congenitally so weak a constitution and others are so enfeebled by sustained underfeeding that they will never become able-bodied.

[1] *Wealth of Nations*, Bk. I, Ch. 8.

[2] E.g. in the construction of the Canadian Grand Trunk Railway, English labour, though paid at 5s. to 6s a day, was found to be cheaper than local labour, which could be had at 3s. 6d. a day. Brassey also states that the cost of constructing a mile of railway in India was as great as in England, though Indian wages were only from 4½d. to 6d. per day.

[3] *Cf.* Schoenhof, *Economy of High Wages*, and Broderick, *English Land and English Landlords*.

Furthermore, it is not always certain that the increased wages will be so spent as to lead to heightened efficiency. They may, on the contrary, result in a further lowering of efficiency. The workers in general, however, will gain in efficiency from more ample subsistence. The community as a whole will benefit by this increase in strength, but the individual employer who makes the necessary increase in wages will not necessarily be benefited.

This class of underfed workers is one of the most distressing and perplexing social problems. They are ill-paid because they are inefficient. They are inefficient, partly at least, because they are ill-paid. They do not respond easily either physically or morally to possibilities of improvement, and in many cases they remain inefficient when their income is increased from charitable or other sources. In such cases it seems that the only hope is to prevent the children of such parents remaining on the same level.

The efficiency of underfed workers may be improved by an increase of wages. But when the worker receives what is necessary for complete physical vigour, increased wages beyond this point is a surplus which no further increases efficiency. Earnings beyond a certain point, therefore, are not a cause of efficiency, but are rather the result of a higher efficiency. When, therefore, it is stated that efficiency results from wages the statement may be true. When it is stated that high efficiency is the result of high wages the statement is, for the most part, false, and this arises from the confusion of cause and effect.

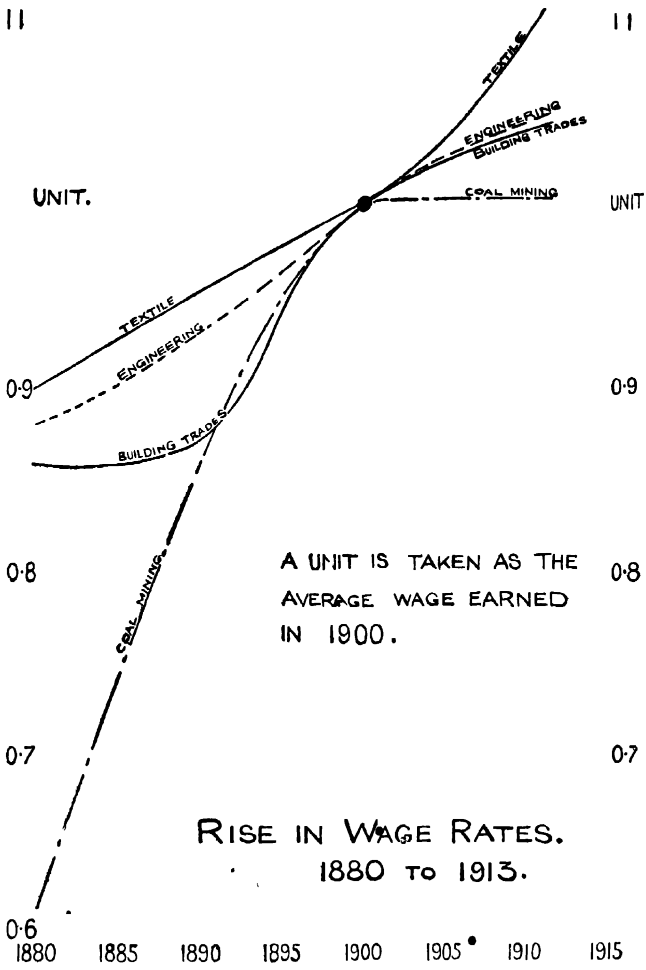
From the racial point of view, therefore, wages may be too low, resulting in the underfeeding of a group of workers. This tends to sap the vitality and lower the physique of the race. Wages from the racial point of view may sometimes be too high, though examples of this kind are more rare. When earnings are too high they may have a demoralizing effect on the workers, producing habits of laziness or intemperance. From the economic point of view, also, wages

may be too high or too low. They are too low when the incentive offered is not sufficient to produce an adequate return. They may be too high as when the incentive of increased earnings fails to call forth the highest capacity of the worker, or when, in producing for an international market, the labour costs are so high that an industry cannot compete with those of other countries.

The terms "high wages and dear labour" and "low wages and cheap labour" are not synonymous. Labour for which high wages is paid may be, and generally is, cheap. Labour for which the wages are low is usually dear. In considering the cost of labour it must be taken in relation to the product. Labour is cheap where the production is high in relation to the wages paid. It is dear where the production is low. Lowly-paid labour may be dear through want of *capacity*. Where through lack of physical vigour and strength, want of training, or other cause labour is inefficient, the cost of such labour per unit of product to the employer may be high. But though this fact is generally recognized, there is another cause of high labour cost which is usually overlooked. Lowly-paid labour may be dear through want of *will*. The fact that men are forced by their necessities to work for a wage which they consider unnecessarily low arouses in them a smouldering feeling of resentment. This naturally reacts on their work, of which they do just sufficient to avert discharge and no more. Under such conditions it is false economy to employ underpaid labour, which, in the long run, is more costly to the employer.

It has been stated that the worker is entitled to a "fair" wage. Does this mean that all the workers in a group or trade are to receive the same fair wage? If so, it is obviously unfair, unless the workers are standardized and equal in all respects as workers. Apart from this, the conception is too vague and indeterminate. Professor Jevons says:[1] "There is no way of deciding what is a fair day's wage. . . . Wages

[1] *Primer of Political Economy*, p. 60.



11
11
UNIT.
UNIT
0·9
0·9
0·8
0·8
0·7
0·7
0·6
TEXTILE
ENGINEERING
BUILDING TRADES
COAL MINING
TEXTILE
ENGINEERING
BUILDING TRADES
COAL MINING
A UNIT IS TAKEN AS THE AVERAGE WAGE EARNED IN 1900.
RISE IN WAGE RATES. 1880 TO 1913.
1880
1885
1890
1895
1900
1905
1910
1915

FIG. 33

vary according to the laws of supply and demand, and as long as workmen differ in skill and strength and the kind of goods they can produce, there must be differences of demand for their product. Accordingly there is no more a fair rate of wages than there is a fair price of cotton or iron." But while this is true, the conception of a fair wage has some value. It has grown out of the standards which are current and customary, modified and adjusted by social and economic changes. It cannot be defined or fixed, as it is a general impression of a tendency to which individual cases only conform approximately. Its value lies in its practical test, which is contentment—contentment of wage-earners, contentment of the consumers, who are the general public. To secure efficient production the hearty co-operation of the worker is necessary, and this can be obtained only when he is contented.

During the past fifty years there has been a vast increase of wealth in the United Kingdom. The standard of subsistence, comfort, and luxury has risen for all classes. Wealth is widely diffused here, not equally diffused of course, but much more so than in other countries. This diffusion of wealth has led to a certain amount of demoralization. The result of over-prosperity in any country has in every case historically been loss in efficiency. When people become over-prosperous they take things easily because they can afford it. The "Gospel of Ease" replaces the "Gospel of Work." Hard work comes to be regarded as an evil to be avoided at any cost; discipline is a thing to be resented; and "comfort and ease" becomes the highest ideal. With increased prosperity life and work become less strenuous. The failure of workers to reach the maximum of efficiency of their labour is therefore largely due to a particular *state of mind*. In other words, the cause is psychological. If the relations between employers and workers is a state of warfare or, at best, one of armed neutrality; if "all is fair in war"; if hard work is an evil to be shunned; if an "honest" day's work consists in the

smallest possible amount which will be accepted; if allegiance and loyalty are duties owing to the trade union but never to the employer, the result is inevitable. Such a mental condition must react on the physical powers. Productive efficiency is reduced; labour cost and selling price are increased. Increased price results in lessened demand, which means reduced production and decreased employment.

CHAPTER XIV

PRODUCTION

DISTRIBUTION OF PRODUCTION COSTS

IT has been previously noted, when considering different aspects bearing on production, that there were four fundamental factors, viz. raw materials, capital, direction, and labour. The costs of production, which constitute the remuneration awarded to the above factors, are made up of different headings and with variations in the order of their relative importance according to the industry concerned.

For example, iron and steel or textile industries have low labour costs but a high capital value. The distribution of costs may be shown for the engineering industry from the following information published by the Committee on Industry and Trade in a Survey of Industries (1928).[1]

ENGINEERING

Heads of Costs		Distribution of Cost
Materials		46·1%
Wages and Salaries—		
Direct Wages. . .	20·5%	
Indirect Wages . .	13·7%	
Salaries . . .	1·5%	
		35·7%
Power, Light, Water, Heating, Property Tax, Depreciation, Maintenance, Rates, and other charges		18·2%
Total . . .		100%

As contrasted with engineering, in the basic pig-iron industry materials amount to 80 to 83 per cent and wages

[1] *Further Factors in Industrial and Commercial Efficiency*, p. 136.

and salaries about 10 per cent, steel ingots give a distribution of costs in which wages and salaries receive from 4½ to 6 per cent, materials taking from 86 to 89 per cent.[1] A different variation in the distribution is shown by the bleaching trade; here materials amount to 20 to 30 per cent, wages 35 to 45 per cent, and overhead 45 to 25 per cent.[2]

Four Fundamental Problems

From an economic point of view an engineering product, or any other commodity, does not become a finished product until it is sold. With increasing competition and apparent excess of supply over demand the obvious course, to ensure maintenance of demand, is to reduce, and still further reduce, the cost of production. This may be done efficiently only by systematizing production, i.e. by establishing production control on a scientific basis in the works.

The following fundamental problems arise and may be considered in order, since they are of vital interest to the management of production—

1. The specific article to be produced.
2. The amount to produce.
3. How the article may be produced.
4. The cost of production.

In considering briefly some aspects of these problems it may be said that neither problems 1 nor 2, although they may influence problems 3 and 4 in a close relationship, belong to the production division proper, but to the commercial division. Hence any discussion of the first two problems, however brief, will not strictly pertain to the scope of this chapter. It will be sufficient to state that in the relationship mentioned a considerable effect upon the efficiency of production results from the accuracy of sales estimates, the creation of an increasing demand,

[1] *Further Factors in Industrial and Commercial Efficiency*, p. 80.
[2] *Ibid.*, p. 85.

and the influence of the design of the product. It is obvious that between manufacturing and selling there must be an intimate relationship which will always remain an essential factor in the success of production. A certain amount of reference will, however, be pertinent to both the first and second of the above-mentioned problems of production in the considerations given to the question of standardization of product. This will be reverted to at the end of the chapter.

How the Article may be Produced

Efficiency in competitive production depends upon obtaining the maximum volume of output per manufacturing unit per employee and per unit of capital utilized. Any increase of mechanization in manufacturing, while proportionately diminishing the labour cost per unit output, also raises the efficiency of the workers. Capital charges are increased but as the volume of production output increases, the overhead costs tend to decrease and thus lower the unit cost of production. When the volume is large in numerical quantity the manufacturing methods which consume the least workshop time are usually the most economical.

Modern tendencies in scientific organization and administration stress the economic importance of production factors such as works efficiency, lowered cost of power, administrative economy, reduction of labour costs, all possible replacements of obsolete plant and methods with modern equipment and more refined processes, and the elimination of all forms of waste in materials, power, and time.

It has been noted above that only in the scientific treatment of machines, methods, men, materials, and money can efficient production be realized. It has also been noted that only by the co-ordination of specialists can the volume of production to the magnitude planned be maintained.

The first essential of economy in the shops implies producing with rapidity. In this, handling work quickly at the machines and reducing preliminary operations of

chucking, setting, and adjusting to the absolute minimum is the important factor. The second essential of economy is the elimination as far as possible of "handwork" operations, and the substitution of accurate machining to predetermined dimension limits for what was formerly "fitting"; the latter being usually an uncertain and unknown quantity as regards cost.

Mr. E. T. Elbourne states that ultimate efficiency depends upon the extent to which the efforts of all individuals in the production division are successfully concentrated on the manufacture of each specific unit or "part." Each individual must be able to work independently without any question being raised about whether the work of another individual will be completed in time, or will be the correct size or the right quantity to assemble with his own.[1] In other words, the divisions of the work of production based on the "part" as a unit for manufacturing purposes must function in mutual harmony. This may be stated briefly thus—

The work done by individuals, in manner, in time, and in space will be governed through a general plan, predetermined by the time allotted for the completion of the total work. The manufacture of each part will be independent of the rest and of the final assembly; the safeguards against error will be the utilization of the dimension-limit system and of a system of efficient inspection for the components at each stage of manufacture.

Jobbing Production

Production for immediate requirements, that is, the manufacture of articles each of independent design to suit immediate orders, is known as jobbing production. Such a system of manufacture requires highly-skilled labour, adequate technical knowledge and wide experience on the part of the management, and sufficient flexibility in the plant to allow of managerial ingenuity devising cheap

[1] *The Management Problem*, p. 80.

alternative processes. Promptness in obtaining material is often more important than the cost of it, since in this type of production stocks will not be carried except those which are absolutely standard.

General Production

In general production every advantage is taken of repetitive work. It may be defined as the production of a number of different types and designs of articles each of which is manufactured in batches according to sales demand and the amount of stock that the enterprise is willing to carry in order to keep up a determined turnover.[1] Careful pre-planning of manufacturing details is necessary in order to avoid delays and to ensure the economical use of both labour and machines. Materials are selected and purchased under technical advice and transportation is carried out with a high degree of systematization.

General production often allows of the separation of processes on the basis of product, so that the necessary machines are installed in each department devoted to the complete manufacture of a particular line of product. Otherwise, the lay-out is arranged to permit of the separation of products on the basis of manufacturing operations.

Mass Production

In this country, owing to the general industrial character, the temperament of workers, and the difficulty of eliminating competition, general production is the most common and will remain the most important type of production for many years. Over two-thirds of the number of engineering industries in Britain are carried on under general production principles.

On the other hand, mass production, through modern publicity and the impressiveness inherent in its method of manufacturing, is given more importance than the system actually warrants. True mass production is strictly limited

[1] T. H. Burnham, *Engineering Economics*.

to the condition that a large market must be available for a constant absorption of the vast quantity of standardized products. In this respect, however, a tendency has been noted in the ordinary economic law of supply and demand to adjust itself to meet the peculiar conditions arising as a result of mass production. Instead of the demand arbitrarily determining the supply, the supply, through the increasing reduction in price consequent on the enormously augmented output, and with the aid of intensive advertising, often creates the demand.

The chief disadvantage of mass production lies in the inflexible nature of the special plant that requires to be installed for producing a thoroughly proved and standardized product.[1] In many types of productive enterprises, which are termed, somewhat generally, as mass production, the real nature of their manufacturing is the result of general jobbing and a certain amount of mass production. The automobile industry, which represents, in this country, the most popular illustration of mass production in engineering, may be cited as an example. Certain parts of a car will be produced on mass-production lines. Many other components, dissimilar in nature, pass through common production centres, the machines in which are altered in setting to deal with the several kinds or sizes, at determined intervals. In relation to the quantity of components or to the nature of the processes involved other parts are manufactured in batch production.

Primarily, mass production requires a scientifically balanced scheme of production and planning, with a specialized plant and specially trained operatives to perform subdivided repetitive tasks. The salient characteristic of mass manufacturing is the use of the conveyor which moves at a constant speed, so timed that operators on an assembly line can work at their most efficient pace.

For efficient functioning mass production requires conditions of continuous production thoroughly standardized,

[1] See p. 89.

over which a scientific method of control guards against the possibility of dislocation in the organization. The real work underlying the efficacy of production of any specific product is done in the drawing office and planning department. Machines, jigs, templates, gauges and handling equipment are each specialized according to the work, and are arranged to keep in operation an uninterrupted progress of different processes right up to the final assembly.

The use of gauges and the frequent inspection of parts is imperative. Gauging is largely a matter of adherence to standardized "limits" and "fits," involving the employment of "go" and "not-go" gauges. Manufacturing allowances must be prescribed with great care to facilitate the necessary speed of assembly.

Plant Arrangements

Many industries are seasonal, and show a high peak in their output curves only for a few weeks in the year. Mr. A. C. Whitehead in his *Planning, Estimating and Rate-fixing* says that whatever the nature of the character of production in an industry, programmes should be arranged with regularity; the capacity of the plant being determined by the probable peak load, and arranged to suit long-period programme requirements. Shorter period variations may be provided for by adjustments in the number of man-hours worked. Or, in the case of a variation in short-time output of a mass-production plant, since the capacity of the plant may often be far from uniform in every part, intensification in laggard or weak production centres may result in an increase of the total output. This is done to best advantage by installing standard new machines.

In all plants the output is determined by the weakest production centres. Highly efficient centres are slowed down by inefficient machines in other centres. The capacity of plants will be determined from the output required, according to the following allowances: General and jobbing production will require a proportion, between

theoretical plant capacity and actual output, of 100 to 60; while for mass production the proportion should be 100 to 75 or 80. In many instances where it is found necessary to provide additional machines to do work which, theoretically, the original number could do under normal conditions the maladjustment is often due to inefficient planning.

It may be noted that for general and jobbing production machines as a rule are laid out functionally, i.e. all milling machines in one section of the works, all drilling machines in another, all lathes grouped together somewhere else, and so on; while for mass production machines are grouped in such a way that the required sequence of operations is performed as the material and components follow prearranged routes to the final assembly, see Fig. 34. With functionally arranged machines, transport is often a very expensive factor, but against this there are factors of definite advantage: the consequent specialization in given operations makes highly-skilled operators and gives lower machine-shop costs than would be possible if each worker has to work through a wider range of operations; and the better utilization of functional foremen.

Certain types of manufacture have variations in the design of the product which make it impossible to arrange machines in continuous lines. In addition the constant movement of work from department to department, with a consequent slowing up of the flow of work, brings difficulties of control, increased overhead expense, and a greater division of responsibility. Thus, in works engaged in the manufacture of a product which varies in size, the processes should be carried out on batches of the component parts; the parts varying for the different sizes, but in many instances some component parts will be common to several of the different sizes of product. Manufacturing operations are segregated by the main and minor parts rather than by processes. All parts of a similar nature, or all parts of a given assembly unit, will be completed in one department.

Two divisions follow: (1) The separation of products on the basis of components, (2) a secondary separation by similarity of parts.

An example may be considered in the manufacture of machines built to the same general design; many of the parts of different-sized machines being interchangeable.

Fig. 34 shows the arrangement of plant which may suit the manufacturing processes. Material flows along the left-hand passage extending the full length of the shop. To the left of this passage are arranged storage spaces for the incoming material. The centre of the shop is divided into various manufacturing sections, with the final fitting out and testing department at the extreme end of the shop. The passage placed on the right contains the main assembly route; to the left are placed the sub-assembly benches, store-room for finished parts, and inspection benches respectively. The route to be followed by each part is indicated by dotted lines.

In general, large outputs may be secured by arranging the plant for the intensive production of units, each variety of unit having its own manufacturing section; or by arranging the plant according to each size of product. If there is any interchangeability of components, production efficiency may be increased by manufacturing those components in the section where the majority will be used.

Both these arrangements depend upon line assembly for efficient functioning, and in each the work of both the planning and the progress departments is performed easily and smoothly. The work in hand should, as far as possible, be so apportioned to keep most of the machines approximately at full capacity during normal working hours. The maintenance of regular supplies for assembling will be comparatively simple, alterations to the setting of machines are rarely required, and the efficiency of machinists may be developed to a high degree.

Where the plant has the machines already arranged in functional order, large-volume production will keep the

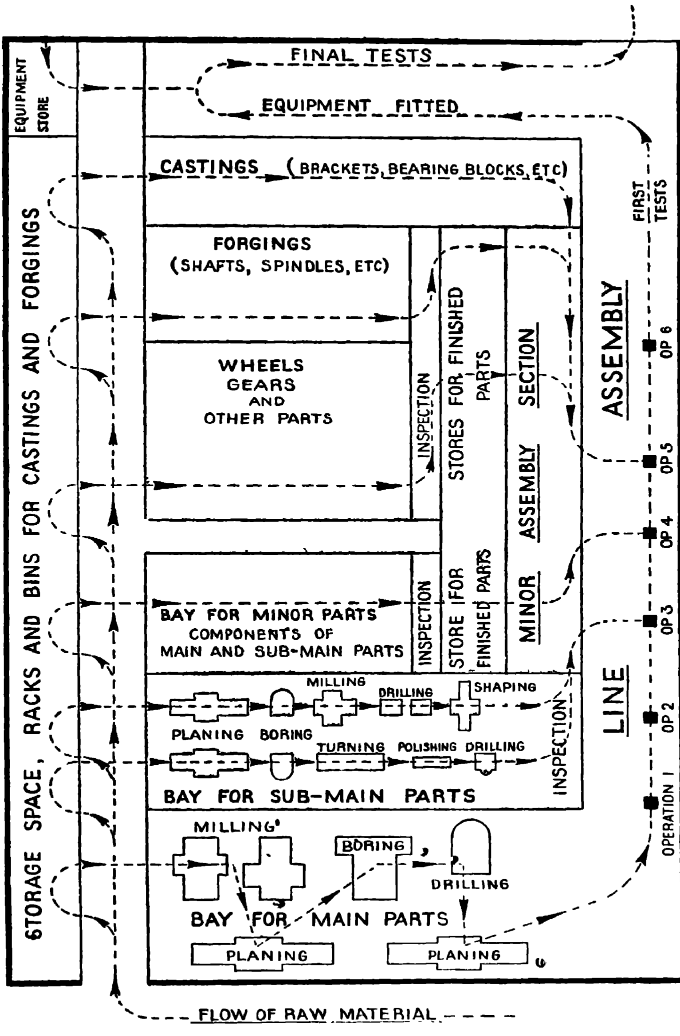

EQUIPMENT STORE
FINAL TESTS
EQUIPMENT FITTED
STORAGE SPACE, RACKS AND BINS FOR CASTINGS AND FORGINGS
CASTINGS (BRACKETS, BEARING BLOCKS, ETC)
FORGINGS (SHAFTS, SPINDLES, ETC)
WHEELS GEARS AND OTHER PARTS
INSPECTION
STORES FOR FINISHED PARTS
ASSEMBLY SECTION
MINOR ASSEMBLY SECTION
BAY FOR MINOR PARTS COMPONENTS OF MAIN AND SUB-MAIN PARTS
INSPECTION
STORE FOR FINISHED PARTS
MILLING
DRILLING
SHAPING
PLANING
BORING
TURNING
POLISHING
DRILLING
INSPECTION
BAY FOR SUB-MAIN PARTS
MILLING
BORING
DRILLING
BAY FOR MAIN PARTS
PLANING
PLANING
ASSEMBLY LINE
FIRST TESTS
OP 6
OP 5
OP 4
OP 3
OP 2
OPERATION 1
FLOW OF RAW MATERIAL

FIG. 34

machine shop on full load at the expense of excessive transport charges and too many alterations in machine settings. The planning and control of production will tend towards undue complexity. Reserves of components and materials will have to be kept on hand in order to ensure regularity in assembling. There is, however, one advantageous aspect in the functional arrangement of machines for large-volume output in that the total quantity of plant will be less than that required by the above-mentioned plans.

The conditions in modern intensive production have tended to displace overhead shafts in workshops in favour of self-contained electric drive for each machine. Machines can thus be arranged more economically as regards space and more conveniently for operating. Mr. Whitehead suggests that comparatively small machines may be made portable with advantage, especially as machine-grouping determined by the flow of work is much more efficient than functional machine-grouping. If comparatively small machines are considered more as portable tools it should not be prohibitive to lay rail tracks through a machine shop and thus give semi-portability. Lack of balance would be a negligible factor, since all modern machines of good quality are extremely well-balanced. The underlying idea is that the small movement of few machines will offset the possibility of having to move thousands of parts a distance that may often amount to many miles.[1] It is a well-accepted fact that machine arrangement should always be first determined according to the type of production instead of having to suit the particular plan of the building.

In modern works where the machine-shop lay-out has been carefully subjected to motion-study analysis for the purpose of arriving at the correct sequence of manufacturing operations with the minimum of transport for the product, the result is often surprising. From the existing lay-out of straight lines, plenty of gangway space and large material

[1] *Planning, Estimating, and Rate Fixing*, p. 289.

dumps, the change turns the new lay-out into what resembles an indiscriminate arrangement of equipment. Yet almost half the original floor space is saved, transport costs are diminished, and material dumps almost disappear. Frequently, the new lay-out places combinations of different machines in single groups for one operation by one man, thus eliminating walking time and time spent bringing the work to one machine and sending it on to another.

The idea of semi-portability in plant is already applied in several American plants. These have machines equipped with complete control gear that can be readily moved as a unit, the plants being wired with overhead ducts. It seems that the modern tendency is to move in this direction from the traditional conception of permanency in plant with its individual units set in concrete foundations and with ample aisle space around them.

Machines

With regard to the installation of either standard or special-purpose machines, present-day practice tends to favour the former rather than the latter type. Three causes influence the displacement of special machines—

1. The rapid development and improvements in machine-tool design and in methods of production.

2. The fact that keener competition causes more frequent improvements and changes in the design of products and hence corresponding revisions of equipment.

3. The continual development in multiple purpose equipment increases the adaptability, scope, and productive capacity of standard machine tools.

Standard machines to suit the requirements of most engineering establishments necessitate their being easily convertible to deal with a wide range of work and to meet changes in the design of the product. In certain cases a few manufacturers engage in the production of complicated products in sufficiently large numbers to justify the greater expense of special machines which are equipped with

integral jigs or fixtures designed for the performance of certain series of operations on certain components. Large savings in production costs follow, but the initial cost of the special plant and the fact that a single change in the design of the product usually means the expense of new machines, and also a considerable loss in scrapping the old ones, develop an increasing tendency to avoid such means of lowering production costs.

The demand for flexibility of equipment has resulted in the production of very adaptable capstan lathes, turret lathes, milling machines, and complex drilling machines, most of which are built of standard units.

Machines and Motion Economy

It was noted above that an essential factor in economical production is rapid handling at the machines and the reduction of preliminary operations of chucking, setting, and adjusting to the absolute minimum.

In an average analysis of machines used in any large works the idle machine time amounts to about 77 per cent of the total working time; of this 35 per cent is absorbed in handling, 13 per cent in setting up, and 29 per cent is due to shortage of work or mechanical breakdowns. Hence the time employed in effective work is only 23 per cent of the total.

Mr. A. C. Whitehead[1] divides the series of processes in production into certain numbers of operations for each process and each operation into a number of constituents. Constituents consist of simple motions which include a complete cycle of forward and return sets of motions. In planning ordinary engineering production ultimate simple motions are rarely considered in order to avoid complexity. An example of an associated set of motions is the raising and lowering of a drill spindle, exchanging drills and other tools, setting work in the

[1] A. C. Whitehead, *Planning, Estimating, and Rate Fixing.*

fixture, and removing it when finished. Or another example: a simple lathe operation may be divided into handling the work, manipulating the machine, cutting away the surplus material, gauging, attention to tools, resting periods, and so on. Any process in manufacture may consist of one, two, or more operations. The fewer the operations the more economical becomes the production. This, however, is completely controlled by the type of labour, the plant, or the volume of output which may be the decisive factor in any particular works.

"If an operation be completely analysed into constituents for which the proper performance times are known, the total time which the operation should consume is also known. . . . Investigations widely made show that there is no appreciable difference in the speed of working in different parts of the country as regards the constituents when the conditions are similar. The only conditions which need be taken into account are those which cannot be controlled by works management, namely, the massiveness of the product and the quantities made."[1]

In works where constituent times, and hence motion study, are of importance, many changes have to be made in existing equipment or on standard machines. Machine-tool designers keep as their primary object the achievement of maximum automaticity rather than the proper co-ordination of the machine-operator's hand motions. The tendency in machine tool design towards complete automaticity should be controlled by the fact that since the period of workshop equipment life is continually shortening, the machine may in many instances fail to pay for itself. Consideration of the operator who has to make the fullest use of the equipment in order to justify the cost of installation is of primary rather than secondary importance.

Motion-economy principles should be taken advantage of, and the significance and importance of motion economy should be reflected in machine design. For example, there

[1] A. C. Whitehead, *Planning, Estimating, and Rate Fixing*, p. 4.

is one maximum working area for each hand of an operator, and all work areas beyond these require additional expenditure of energy. The areas may be defined as that formed when an operator, using his arms as radii, describes two arcs on a machine table without shifting his feet. The normal working area for each hand is covered approximately by the arcs drawn with the extended forearms centred at the elbow-joint; the elbow-joint being kept fairly close to the body. The area thus covered are the desirable working areas in which all tools, materials, gauges, etc., should be located.

Two complete sets of motions have to be considered in operating a machine: (1) those pertaining to the actual working of the machine; and (2) those used to prepare tools and material. Machines requiring constant starting, stopping, regulating, being supplied with material, and so on, should have all controls located so that needless and ineffective motions are avoided. Hence, instead of arranging levers and controls in rigid adherence to the principles of dynamic and mechanical simplicity, an effort should be made to locate them within a minimum area and in the most convenient zone. Controls are usually denoted by letters and figures which specify the mechanisms controlled and the variations in speed required. Inefficiency due to ill-directed motions and arising from erroneous reading of figured and lettered plates may be prevented by replacing existing controls with a colour control system. The use of colour, which has proved of considerable value to progressing, storekeeping, and other phases of production, will increase economical operation by preventing confusion, loss of time, and errors on the part of the operator.

The conventional design of equipment provides for the handling of one component or one set of components at a time. Idle time due to setting up material in a machine is one of the hardest elements of cost to control. The handling of material in and out of the machine frequently requires time far in excess of the actual machining time.

In mass-production work the loss due to setting-up time is reduced to a minimum, but in other forms of manufacturing more attention should be paid to the reduction of this item. It may mean in many cases the margin between economical production and the failure to justify the existence of the machine or equipment.

Frequently, the changes required are not fundamental nor expensive, but in other cases a complete re-design of the machine is indicated. It is, however, becoming more apparent that machine designers are breaking away from the traditional principle of adapting the man to the machine in favour of motion-economy principles of adjusting the machine to suit the various human limitations of the operator.

THE EXPENSE OF PRODUCING

In considering the costs of production the factors, materials, men, machines, etc., may be defined in greater detail. Materials mean those wholly or partially utilized in the finished product to the exclusion of materials such as fuel, lubricating oils, paint, polishing materials, and so on. These, though used during the process of manufacture, cannot easily be allocated to specific products; hence their cost may be included under other charges. Labour may also be divided under two headings: the direct labour engaged on the actual work of production and the indirect labour which is necessary for the efficient work of the former. The distinction is frequently incapable of being clearly defined under actual working conditions, but a share of the total costs of indirect labour will be charged to the finished product. From the production point of view neither direct nor indirect labour may take precedence one over the other with regard to importance or necessity.

Administration may be separated into two factors, one being placed under the labour costs and the other under the charges to capital. The latter may be given further consideration, since they include the expenses controlled by

the works, as well as higher administrative expenses, selling expenses, after-sales service, and so on, which are independent of works control. The former include costs which may remain constant whether the works is busy or slack, together with costs which vary proportionally with the degree of activity of the works. Fig. 35 illustrates diagrammatically the diffusion of the total costs from materials to the selling price of the finished product.

The estimating of the cost of any unit of output is a complex process. Systems for calculating labour and material costs are sufficiently accurate in most works, but it is much more difficult to determine accurately the proper allocation of the other expenses incurred in production. The scientific analysis of these expenses is, however, rapidly tending to find an important part in modern production. It may be taken that they are divided into two primary divisions: those expenses outside the control of the works and those directly controlled by the works. The latter may then be subdivided into fixed and variable expenses, as mentioned above. Both divisions are referred to under the term overhead charges or oncost.

The Allocation of Oncost

Overhead costs are a powerful influence upon industrial development, and their allocation constitutes the vital portion of all costing problems. Various methods of "spreading" the overhead costs are used in order that each product or class of product may make a proper contribution thereto; each method being chosen as the most suitable to the particular industry concerned.

A common plan is to allocate oncost as a percentage on direct labour cost. This, however, will not give an exact cost for each product, or give a true overall cost if the production is of a varied nature. In addition, the variation of efficiency in individual workers is overlooked. For practical purposes its degree of accuracy is high enough, and the speed with which the oncost may be estimated is

DIFFUSION OF COSTS

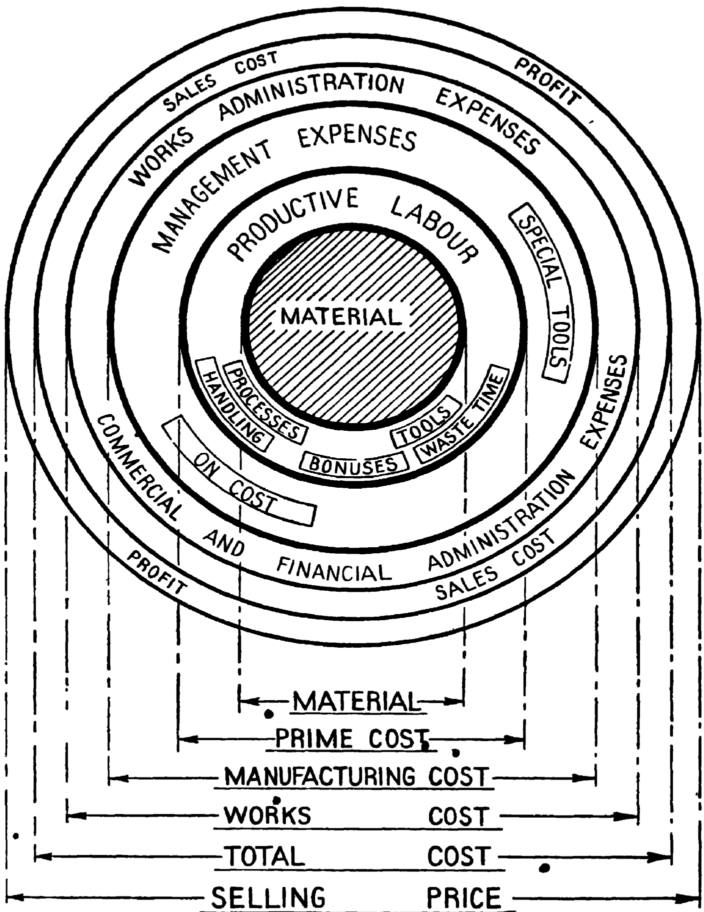


FIG. 35

a definite advantage. The percentage is calculated by comparing the total direct wages with the total works expenses over an appropriate period. In large works a separate percentage rate may be calculated on each class of wages and on the total cost of running the shop.

Another method is to reckon oncost as a percentage of the prime cost. A number of disadvantages are apparent in this plan, since it also fails to give the true cost of separate products. Where the materials cost is a relatively large fraction of the production cost, a great degree of inaccuracy will enter if the price of materials fluctuates. Where the product seldom changes the plan will enable a satisfactory enough average to be struck, but many firms add an extra percentage to the cost of the materials to cover handling, transport, and storage charges, and a percentage to wages to cover general expenses.

The simplest method is to assess the oncost on the expenditure per unit product. This, however, entails the condition that the products are of one kind, or that one kind of product passes through the same manufacturing processes in approximately equal times. The method does not always react to any savings in manufacturing costs which may accrue from various processes.

All these methods enumerated do not take into account the important factor time, which is itself an approximate gauge of certain portions of the overhead and a related unit of others. Thus, proportional to the time factor would be rent, rates, taxes, insurance, depreciation, obsolescence, management salaries, and so on; and strongly dependent upon time would be repairs, power, lighting, heating, tools, and indirect labour. Two rates are therefore possible: a process-hour or man-hour rate and a machine-hour rate. Both these rates bear out the general thesis that oncost does not vary with wages, and that the output rather than the time should carry the oncost. The man-hour method takes into account differences in grades of labour and individual efficiency. Inaccuracy, however, will

follow if many dissimilar products are being turned out. The machine-hour method will cover all expenses except direct wages and materials cost, and the hourly rate is struck either for each machine or each group of machines in production centres. The rate will depend (for a given machine) upon: (*a*) floor space—from which is calculated its share in rent, rates, etc.; (*b*) its value on the books—from which are calculated factors governing depreciation and insurance; (*c*) the expenditure on indirect labour to keep the machine functioning efficiently; (*d*) consumption of power, oil, repair materials, etc.; (*e*) maintenance costs; and (*f*) amount of idle time. The rates may vary from two shillings per hour in the case of small machines, such as sensitive drilling machines, to fifteen shillings per hour for large special precision machines.[1]

Although in practice the rates may vary widely, on the whole the "man-hour" and "machine-hour" basis of allocation of oncost is the most accurate of all methods. There is no method of scientific allocation of overhead that may be regarded as suitable for all industries. Even with the most meticulous care or with the most elaborate system the results will always be approximate.

Generally speaking, oncosts should be allocated per productive department with full regard to actual circumstances and working conditions. The method of allocation of oncost should be governed by the choice of the factor which most closely regulates each item, and, hence, from which production and distributive costs may be most efficiently controlled. Where hand labour regulates the costs of production oncost may be assessed by charging a percentage rate per direct man-hour. Where the process is dependent upon machine operations overhead charges may be recovered by charging a percentage rate per machine hour for the period the machines are occupied on each job.

So far considerations have been confined to where machine

[1] A. C. Whitehead, *ibid.*, p. 239.

processes, if not the essential process of the manufacturing, form an important part of it. A brief consideration may be given to a department where hand labour is predominant; a typical one is the foundry. The modern foundry covers many more activities than did its counterpart a generation ago. Castings may now be produced in any of the numerous scientific alloys and in any quantity or size. The proper distribution of costs, especially those which will have to be recovered from the overhead, is immensely important when competition is rendered keen and prices have been brought low. Definite information must be made available as to where possible reductions in the costs of production may be secured.

There are certain specialized mass-producing foundries where costs are effectively analysed over a given period for a large number of identical products. For most foundries, however, jobbing is the typical form of production, and where such is the case, each casting or each batch of castings will have to be costed separately and accurately.

There is comparatively little difficulty in ascertaining the direct material and the direct labour costs. The particular alloys have to be considered, hence the records of each furnace charge must be correctly identified, sent to the costing department which prices it, distributes it over the products, deducting any recoveries from that furnace charge, and finally settles the direct material cost per unit weight of castings. It is also advantageous to measure the coal and other fuel consumption for inclusion in the direct material cost, as well as to record the variations in furnace costs for different mixtures of metal. The direct labour cost is obtained from the time booked by the different workers to their respective jobs by means of time cards or time boards. The workers include moulders, coremakers, sand-blasters, fettlers, etc., who are required for each casting.

As in machine processes, the overhead charges are the most difficult to ascertain accurately. Broadly, the oncost

represents the balance of cost after material, coal, fuel, and direct wages have been calculated. This balance may be spread over the total output, but this method does not differentiate between different types of castings.

The total overhead may be divided departmentally, as advised above, and the result added to the job cost by the separate costs of the processes through which the product passed. For example, melting will be the cost up to the instant of pouring the metal, above those costs which have been accounted for in direct content material. All the products will share this cost proportionally. Moulding is the foundry cost above direct labour and direct machine cost. Coremaking, fettling, and sand-blasting and grinding if required, may be treated in exactly the same way as moulding. Hence, all costs are included and the cost is not added for any process which a particular casting may not require.

Stated briefly, the allocation of oncost by the departmentalization system implies setting out the estimated total of every item of expenditure over, say, twelve months, analysing the consumption per department, and then striking a rate per man per week per process department, a rate for machines used and a rate per ton or per hundredweight of material. The system based on the flat rate per ton of output is suitable for those foundries whose normal output consists only of repetition products.

STOREKEEPING

Inaccurate costing, bad purchasing of materials, pilfering of stores, and even careless workmanship, are the results of empirical recording of stores. Scientific storekeeping is a development of scientific cash-keeping. Stores balance should be accounted for as strictly as cash balance. Scientific storekeeping implies the existence of a system which should show, at any instant, the charges entered against stores inwards, the charges entered in favour of stores

outwards, the balance of stores daily or after every transaction, and the average value of the balance of stores after each inward entry. The ascertainment of "stores level" should be facilitated by the systematic and accessible arrangement of all stores.

Methods of storing stock are governed by the nature of the material. Coal or pig iron is piled in outside dumps or in special bunkers. Engineering stores are placed in bins or on racks according to their size and nature. Timber must have special provision made against bad ventilation and other detrimental conditions to ensure its careful seasoning. In general, stores protection requires consideration of all risks such as fire, theft, rusting, evaporation, and dust.

Stores control extends from the arrival of raw material to the works to the issuing of the final assembly components to the shops. Both the clerical side and the actual handling of stores must be closely identified with each other; and the scope of the storekeeping arrangements must be comprehensive but not cumbersome, with a centralization of responsibility. The storekeeper should not, however, be made responsible to the works manager as is frequently the case, but to the accountant. Scientific storekeeping has now rendered this is a necessary procedure.

It was noted in Chapter XII that in scientific control of materials the provision and careful supervision of stock-on-hand limits, and methodical ways of checking weights and numbers, virtually reduces storekeeping to an automatic routine and makes an annual stocktaking practically unnecessary. Such a system implies a strict accounting for every item or scrap of material issued from the stores, for each of which a duly authorized requisition is required. Fig. 36 shows a typical form of requisition note which is filled in in triplicate by the foreman or leading hand of the section requiring goods from the store. One copy is retained by the foreman, one copy is kept by the storekeeper, and the third is sent to the Cost Office. The storekeeper issues

the stores stated on the note; the office enters up the credit for stores and debit for the job. In this, the written record and the true volume of stores should agree at any time for both receipts and issues.

Table A tabulates the necessary information required to be set out on a typical stores inward note which is used when ordered goods finally pass into the works through

REQUISITION		No.		
Date		Job No.		
Order No.		Stores No.		
Description				
Quantity	Weight	Unit	Rate	Amount
Issued by		Received by		

FIG. 36

the gate office. All orders for goods are issued in triplicate form, of which one is sent to the gate office and one is retained by the cost office. Thus the gate-office clerk may check the delivery of the stores with the suppliers' delivery note before entering up on the stores inward note the quantity and description of the goods. The stores inward note should also be in triplicate; one copy, thus filled in, is dispatched with the goods to the storekeeper, and one copy is sent to the cost office. The gate-office clerk retains the third. The cost office, after checking their copy of stores inward note with order and invoice, enters it in the stores ledger account. The storekeeper checks his copy with the goods delivered and makes the necessary

entry on the storage card. No stores may then pass out of the storekeepers' control without a corresponding requisition note.

Table B gives the information necessary for a stores ledger card which gives at any time the description and

TABLE A

1. The Date.
2. Supplied by whom.
3. Number of packages and description of goods therein.
4. Particulars of carriage and route.
5. The Order number, the Stock Reference number, and Invoice number.
6. Advised by whom and Received by whom.
7. Particulars of number and weight, and the number of Stock Units (to be used in conjunction with 6).
8. Monetary value, i.e. Rate and Amount.
9. Issued to whom.
10. Particulars of Job for Costing purposes if required.

TABLE B

1. Number of Card.
2. Description of Material or Stock.
3. Its location in Store. Rack or Bin Number.
4. Suppliers' Name.
5. Amount Received, Quantity and Value.
6. Amount Issued, Quantity and Value.
7. Numbers of Requisition Orders and Stores Inward Notes.
8. Maximum and Minimum Levels of Material kept in Store.
9. Reports on Stock.
10. Balance of Stock; Date; Quantity and Value.

FIG. 37

position of any stores, the names of suppliers, results of checks of the records and the actual stores present, and other information. The totals on the stores ledger card should always give the actual stores present at a given date—in the correct quantities.

With regard to further aspects of costing and storekeeping, i.e. the cost of jobs, or if stocks are held while large fluctuations in their value with the market price take place, there are varied opinions as to the best methods of the valuation of issues. If the goods are ordered for a definite job then they should be issued at invoice price, i.e. at cost.

If they are to be held as stock it is usually convenient to value the issues at the average rate of the balance. If the market price fluctuates to any great extent, the difference can be transferred to a separate "Stores Account."

In making up the cost of production of any job, the material leaving the stores is credited to stores account and debited to the production cost account. Wages and oncost percentage, calculated on either the man-hour or the machine-hour method, or from both, are then added to the production cost account. On completion of manufacturing this account is transferred to the distributive cost account. Hence, with efficient working the system gives the profit by the difference shown between the total costs and the total invoice values.

Store ledger accounts can be made up immediately and at any time; and an accurate record of quantities and values of stores constitutes a perpetual inventory without having to check up stores physically. Thus, the management are in an advantageous position to detect inefficiency in stores recording, and in control over materials, and to apply remedial measures before any great harm results.

With regard to facilitating the systematic checking of "stores level" by an accessible arrangement of racks and bins, much may be done in existing stores lay-outs to improve conditions. Years of familiarity with the old positions of racks, bins, and so on in a store often blinds those associated with them to obvious defects. A decided economic advantage is gained by the systematic rearrangement of all former stores location. The accompanying chart (Figs. 38 and 39) shows the results of detailed work in re-planning an engineering sub-store. The advantages gained were—

1. An increase of 30 per cent in rack accommodation.

2. An improvement in methods of gaining access to shelves from central working points. The conditions for direct supervision were also included.

3. An increase of over 60 square feet of floor space was

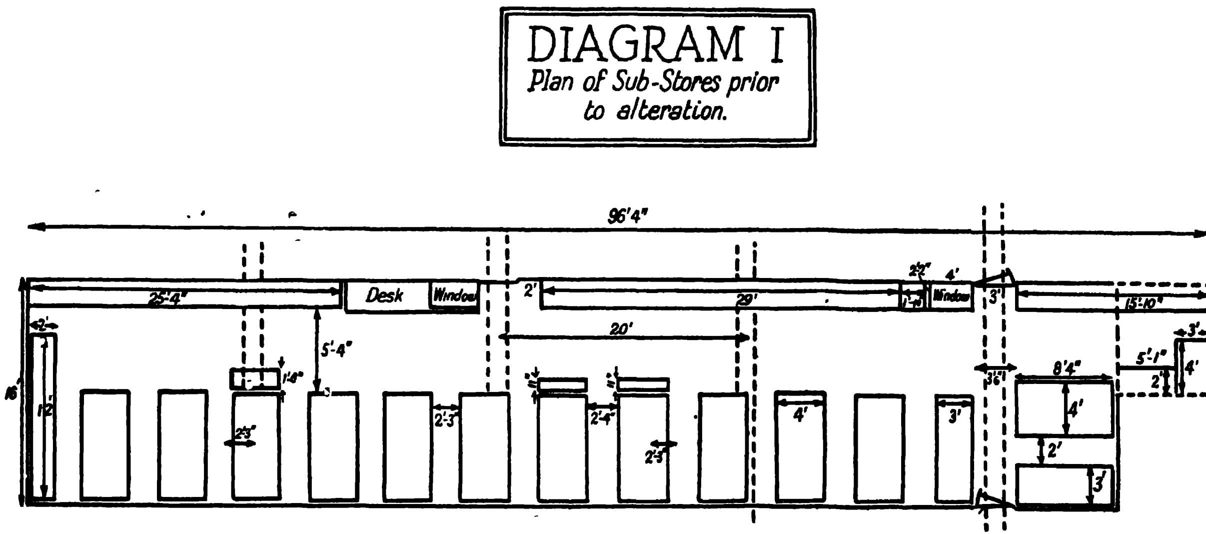


DIAGRAM I
Plan of Sub-Stores prior to alteration.
96'4"
25'-4"
Desk
Window
2'
29'
20'
5'-4"
1'4"
2'3"
2'-3"
2'-4"
2'3"
4'
3'
2'2"
4'
Window
3'
3'6"
8'4"
4'
2'
3'
15'-10"
5'-1"
3'
4'
2'
16'
12'
2'

FIG. 38

DIAGRAM II
Plan of New Layout in Sub-Stores

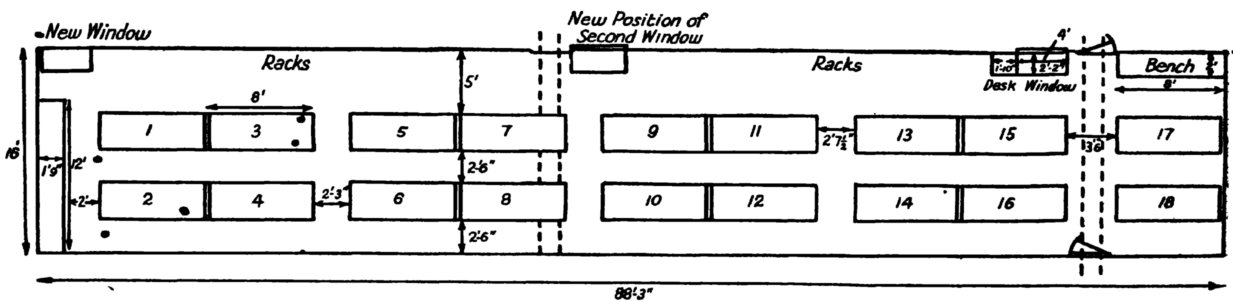


FIG. 39

provided at a point where it was urgently required for the shop.

4. An adequate space was given for increased bench accommodation at the service windows.[1]

Production Control

The main factors in the scientific treatment of production are the processes of planning, routing, scheduling, progressing, and standardizing. The broad aspects of these functions have already been discussed in previous chapters. It is now proposed to consider their relation to obtaining manufacturing efficiency by the steady sequence and smooth running of all operations and processes. This object is attained by systematizing the functions to give independent but mutually co-operative work on the part of every factor in the manufacturing organization. This principle is known as production control.

Production control will require a comprehensive system of records and charts in order to give immediate indication whether the production programme is progressing normally, or at what point the divergence from normal is occurring.

The highest productive efficiency comes only from first-class planning. "It will easily give 20 per cent or 30 per cent more production at less expense from a given workshop than planning of a lower order which, to the uninitiated, looks the same."[2] Whether the production is of a jobbing, general, or intensive nature, control of all manufacturing operations involves a separation between planning the work and executing it. Pre-planning must be based on definite time-tables, with all details carefully considered, in order that the path traced out for the work maintains a smooth, continuous flow. Time taken by "setting-up" or other preparatory work should be brought to a minimum.

[1] H. J. Welch and G. H. Miles, *Industrial Psychology in Practice*, p. 183.

[2] A. C. Whitehead, *Planning, Estimating, and Rate Fixing*, p. 209.

The requirements for production on an adequate scale may be summarized: (1) The nature, the quantity, and the completion date of the product; (2) the number and particulars of all components, the necessary operations and processes involved in their manufacture, and the time and particulars of their final assembly; (3) a definite order of work in the performance of operations on the components, and also in assembling them, together with a facile and accurate method of tracing the progress of each performance, of identifying each component and the order of work as a whole or part, for the purpose of control and final costing; (4) the knowledge of the divisions of time for each operation in order that all components needed for assembly may be on hand at the proper instant. Production control, as a specialized function, will provide the manufacturing department at the correct time with the necessary working drawings, the required tools, special jigs and gauges, operation and process schedules, and the proper material.

"This synchronization of processes is ensured by the scheduling of production"; it is essentially important that the synchronization should be effective where the finished product from one production centre is the raw material for another, or where the output of different centres, together with components purchased outside, converge at set points on the assembly line.

The next consideration of importance after planning is the method of controlling in advance the actual work of production. This is known as routing. The problem is how to arrange a direction and rate of flow so that the material will pass through the sequence of operations with the minimum of transport and handling and in the minimum time. The more highly standardized the product the more simple the problem will be. But whether the routing system is of extreme simplicity or of great complexity the time element is the controlling factor if the plant is to work at full capacity and with maximum efficiency. The heavy

components will be arranged to move the shortest possible distance, while the smaller components may be made in large quantities and transported to the assembly line or shop in bulk.

STANDARDIZATION

Towards the end of 1921 a report entitled "Waste in Industry" was issued by a committee of the Federated American Engineering Societies, of which Mr. Hoover was president. The committee, having investigated six typical industries, showed the losses to range from 29 per cent to 64 per cent with an average of 49 per cent over the industries examined. This meant that roughly one-half of the materials, labour, and energy expended was being wasted or spent without tangible return; and of this waste the committee believed 50 per cent was chargeable to management and 20 per cent to labour. The committee considered that these six industries were typical of all the industries of the United States which had a total annual output of $60,000,000,000 manufactured goods. The mind can scarcely grasp the colossal cost of this waste to the country at large.

The chief causes of waste in industry have been summarized as—

1. Low production due to faulty management of materials, machinery, equipment, and men.

2. Interrupted production caused by idle men, idle materials, idle plants, and idle equipment.

3. Restricted production intentionally caused by owners, management, or labour.

4. Lost production caused by ill-health, physical defects, and industrial accidents.

It is recognized that all of this waste cannot be avoided and that some of it can never be eliminated. But much of it is preventable, and the committee believed that enormous savings could be made through standardization and simplification alone.

The principle of standardization is active not only in

production but in the organization and administration of industries. In principle, however, standardization is used in two totally different senses, viz.: (1) That prescribed, supervised, and enforced by law, which covers the elementary standards of length, volume, weight, value, or energy, as well as other standards of purity, strength, or quality; (2) the voluntary determination of standards by industries, of size, pattern, quality, strength, value, etc., with a view to eliminating the waste caused by unnecessary multiplication of the types of product in use.

The World Economic Conference, which was held in Geneva in May, 1927, advocated "Rationalization of Industry," in regard to which the Conference stated—

"The first of these problems is that of rationalization, by which we understand the methods of technique and organization designed to secure the minimum waste of either effort or material. It includes the scientific organization of labour, standardization of both material and of products, simplification of processes, and improvements in the system of transport and marketing. The Conference considers that such rationalization aims simultaneously—

1. At securing the maximum efficiency of labour with the minimum of effort.

2. At facilitating, by a reduction in the variety of patterns (where such variety offers no obvious advantage), the design, manufacture, use, and replacement of standardized parts.

3. At avoiding waste of raw materials and power.

4. At simplifying the distribution of goods.

5. At avoiding in distribution unnecessary transport, burdensome financial charges, and the useless interposition of middlemen.

Standardization has thus become a part of rationalization—a movement which is likely to be of enormous importance in industrial development."

The Economic Conference recommended that "Standardization of materials, parts and products of all types which

are of international importance should receive systematic attention on international lines." The Balfour Committee of Industry and Trade stressed the importance of standardization as a factor of industrial efficiency, while the Imperial Conference of 1926 urged the Government of the Empire to take all possible steps to promote its development. The emphasis laid on standardization by three such authoritative bodies is a sufficient indication of its importance in present-day industry. Industrialists are beginning to realize the significant part which standardization will play in the development of industries, and in the struggle for foreign markets in the near future.

Before the dawn of history man selected from the gifts of Nature those things which served his needs. It was only long afterwards that he devised utilities to meet those needs. The old idea persisted in the feeling that industrial products must be accepted as they are given. There is now, however, an increasing insistence that products must be specifically designed to fit the needs. In other words, it is the use which determines the standard.

With the growth of precision of measurements of all kinds it is now possible to measure the quality or fitness for use of commodities, the utility of devices, the effectiveness of processes. These require standards of quality, performance, or practice stating in measurable terms the magnitudes determining net utility, briefly described as "specification." When specifications become definite and "established by general consent" they are standards.

Standardization sets up fixed patterns or procedures as a substitute for individual discretion or fancy. It includes both quality of material and excellence of workmanship, and is an endeavour to obtain the best instrument or material for a specified end. "Industrial standardization, according to the procedure of the British Engineering Standards Association, is the adoption of what is economically best in present practice, without any attempt to set up an ideal which may be too costly for industry to achieve.

Time and progress are allowed to bring about improvements. It is really a process of simplifying and unifying the requirements of industry by agreement among all parties concerned." [1]

Standardization makes permanent each advance in industry and in civilization. It makes certain that never again shall there be a "lost art," for each art and craft has its own measured records or standards. It conserves gains while serving as the basis for future improvements and advances.

In America a distinction is drawn between standardization and simplification, or as they call it "simplified practice." Simplified practice deals solely with the reduction of the variety of types, styles, and sizes of commodities to the fewest possible number, while standardization is regarded as a more technical and scientific function. In 1922 the Division of Simplified Practice was established as a branch of the Bureau of Standards in the U.S. Department of Commerce. When the producers, distributors, and consumers develop a scheme of simplification which will be beneficial to all, the Division of Simplified Practice assists in securing its general adoption.

In considering whether standardization is necessary or desirable it is not enough to consider merely whether it is justified by its effect on business and industry. They, after all, exist only to supply the material needs of society. Standardization must therefore base its justification on the influence it exerts on society as a whole.

There is a marked similarity between the workshop of Nature and those of industry. Nature, influenced by the varying conditions of environment, is continually creating variations in plant and animal life. If all these survived the world would be filled with an innumerable variety of forms. But each new variety is tried out in the great testing house of life. If it is faulty in design or unfitted in any way to hold its place in the great struggle for existence, it dies out and leaves no descendants. If, on

[1] C. le Maistre, *Industrial Standardization and Simplification.*

the other hand, it justifies itself and is adjudged worthy, the new form finds a place for itself in the world. But more than this, certain type-conserving forces operate to give it a degree of permanence and stability. Nature thus has established a system of discrete types which we can enumerate and classify. Each type has standardized organs and functions, though the members exhibit variety and individuality.

There are thus two fundamentally different tendencies in Nature—one perpetually operating to produce variation, while the other eliminates the less useful variations and concentrates on the reproduction of the relatively small number of types which have withstood the test of life. Variation is the creative force which produces the better type; standardization establishes it as the prevailing type and as the basis from which fresh improvements may spring.

So it is in human society. Man, however, has this advantage over Nature, that he has the ability to experiment. The creative power of thought produces variations from the normal. The selection processes of test, experiment, and use, determine those which are of value. Standardization fixes them as prevailing types from which fresh advances can be made. Thus, with the solution of a problem, standardization relegates it to the realm of routine and frees the mind for creative work on problems yet unsolved.

The individualistic critics of standardization fear that it will retard invention and progress and result in a world of universal mediocrity—of drab, dull uniformity where they will eat standardized food, drink standardized drinks, wear standardized clothes, and live in standardized houses. This, in fact, is the "standard" objection to standardization. They do not realize the extent to which they accept without comment standardized conditions. The railway or tramcar that conveys them to business, the typewriter and telephone in their office, the clothes they wear by day or evening, the conventions of the society in which they move, the laws of the country, are all standardized.

There is, however, little fear of such a state of affairs. Standardization is, of course, like everything else, liable to abuse. The chief abuse arises from a limited view of its objective, as where it is used to meet the needs of a particular interest rather than those of the public as a whole. But standardization can only be arrived at by general consent. So long as the community interest is maintained in the fixing of a standard the community cannot suffer. A form of standard which is so rigid that it resists improvement is economically unsound. A standard must represent the best in industry and it must persist only so long as it is the best. So long as provision is made for periodical review, and for revision when necessary, standardization promotes progress and in no way retards invention and initiative.

There is also the fear that standardization may result in loss of artistic excellence and beauty of design. This fear has had much to do with preventing the development of standardization in some of our important industries where æsthetic factors are important. Textiles, the pottery and clothing trades, may be taken as examples. Because a thing is standardized is no reason why it should not also be both artistic and beautiful. Standardization which has brought about a loss of individuality and æsthetic values is the result of competitive efforts put forth in the interests of increasing profits. But since the participation of the consumer in the initiation and development of standardization is assured in British National Standards there is little to fear in this respect. In no case has the work carried out by the British Engineering Standards Association been incompatible with artistic excellence, nor is there much likelihood that it will become so. The belief that simplification might lead to stereotyped designs in these industries has led to the opposite extreme in the needless multiplication of designs.

In the years preceding the war there was a noticeable tendency in manufacturing to multiply the variety of kinds and sizes of products in response to the demand from

distributors and consumers. Competition in service between firms was so keen that customers were permitted not only to depart from recognized standards but to specify such variations as their fancy dictated. During the war period the variety of sizes and types in many commodities was drastically cut. With the return to peace conditions, this war-time experience resulted in an organized resistance in some branches of industry against the wasteful production of a needless variety of types; and an effort to secure further simplification followed. This object was attained "by a process of simplifying and unifying the needs of industry by agreement amongst the producers and consumers and adopting as the basis of the national specifications what was best for industrial practice,"[1] at the same time securing that such specifications would not affect improvement and invention. The following details of simplification and standardization in Great Britain and the United States are illuminative—

GREAT BRITAIN

1. A saving of 5s. per ton or £1,000,000 per annum has been effected through the simplification and later the standardization of steel sections, the varieties of which were reduced from a very large number to 113.

2. Tramway rail sections have been reduced from 75 to 5.

3. Steel telegraph poles have been reduced to four Empire Standard Types, and simplification of overall lengths and loads has been achieved.

4. Colliery rails have been reduced from some 500 sections to 14.

5. The issue of one B.S. Specification for electrical cables has brought about a decrease in the stocks which have to be maintained, one firm alone admitting a saving of £500 per annum from this issue.

6. Well over 90 per cent of the Portland cement output is now in accordance with the B.S. Specification (first issued in 1909).

7. British Standard Whitworth Threads have assisted our export trade, particularly where they have been adopted by the British Dominions and Colonies overseas.

8. The Schedule of British Standard Fine (B.S.F.) Hexagon Bolts, Set-screws and Nuts, Split Pins, Washers and Studs, drawn up in co-operation with and adopted by the automobile industry, will be of increasing utility to all purchasers, users and makers, and bring about national economy. As they become widely adopted these British Standard Sizes should be obtainable from stock from all stores and ironmongers.

[1] *Factors in Industrial and Commercial Efficiency*, p. 290.

UNITED STATES [1]

SIMPLIFIED PRACTICE APPLIED TO PLUMBING

Commodity	Formerly	Now	Reduction per cent
Structural slate for plumbing purposes (estimated)	—	—	84
Range boilers	130	13	90
Hot water storage tanks	120	14	88
Brass lavatory and sink traps	1114	72	94
Average reduction			89

SIMPLIFIED PRACTICE APPLIED TO BUSINESS DOCUMENTS

Warehouse receipt, stock and delivery forms, etc. Invoice, inquiry, and purchase order forms. Bank cheques, notes, deposit slips, notices, etc.	Each previously made in a thousand different forms. There is now one Standard Form for each of these documents.
Average reduction	"99·44/100%" (estimated)

Field	Varieties Reduced		Estimated Annual Saving
	From	To	$
Paving brick	66	4	1,000,000
Sheet steel	1819	261	2,400,000
Reinforcing bars	40	11	4,500,000
Warehouse forms	3500	18	5,00,0000
Range boilers	130	13	5,500,000
Builders' hardware	100%	Items 74% Fins. 29%	10,000,000
Invoice, inquiry, and purchase order forms	4500	3	15,000,000
Lumber—yard sizes	100%	40%	250,000,000
Total			$293,400,000

(Estimated)

[1] The figures in the following tables are taken from "Annals of the American Academy of Political and Social Science," Vol. cxxxvii, May, 1928.

SIMPLIFIED PRACTICE APPLIED TO MILL SUPPLIES, SHOP EQUIPMENT, ETC.

Commodity	Formerly	Now	Reduction per cent
Files and rasps	1351	496	65
Forged tools	665	351	47
Plough bolts	1500	840	44
Sheet steel	1819	263	85
Milling cutters			35
Die-heads, self-opening			75
Grinding wheels	715,200	255,800	64
Average reduction			59

SIMPLIFIED PRACTICE APPLIED TO CONSTRUCTION MATERIALS

Commodity	Formerly	Now	Reduction per cent
Paving bricks	66	4	94
Asphalt	102	10	90
Steel reinforcing bars	40	11	72½
Metal lath	125	24	81
Woven wire fence	552	69	87
Asbestos mill board	10	5	50
Eaves trough and conductor pipe	21	16	24
Concrete building units	115	24	80
Sand lime brick	14	3	78½
Roofing slate	98	48	51
Average reduction			71

SIMPLIFIED PRACTICE APPLIED TO BUILDING MATERIALS, EQUIPMENT, FITTINGS, ETC.

Commodity	Formerly	Now	Reduction per cent
Face brick, smooth	36	1	97
Face brick, rough	39	1	97½
Common brick	44	1	98
Lumber, soft wood, yard sizes			60
Hollow building tile	36	19	47½
Builders' hardware	Items 26%	Finishes	71
Sidewalk lights, sizes	120	6	95
Paint and varnish brushes	480	138	71
Blackboard slates	251	25	90
Tacks and nails	428	181	58
Average reduction			72½

Simplified Practice Applied to General Supplies and Furnishings for Homes, Hotels, Hospitals, Clubs, etc.

Commodity	Formerly	Now	Reduction per cent
Beds, mattresses, springs	78	4	95
Bed blankets	78	12	85
Sterling silver, flatware	190	62	67
Tinware, galvanized and japanned	1154	873	24
Milk bottles	49	9	82
Milk-bottle caps	29	1	96
Hotel-chinaware	700	160	77
Restaurant chinaware	668	177	73
Dining-car chinaware	700	113	84
Hospital beds	67	4	94
Steel lockers	65	17	74
Average reduction			76½

Standardization is beneficial to all classes of the community and tends to increase the productive capacity of the nation and to the elimination of waste of time and materials. The manufacturer gains through more economic production. By the reduction of the number of types or designs produced there is attained—

1. A saving in time in changing from one design to another.

2. Greater specialization in machinery for the production of standard types.

3. A fuller use of labour-saving devices.

4. Less capital tied up in raw materials, semi-finished stock and space for storage.

5. A more accurate cost-accounting system with ability to estimate accurately for future production.

6. Greater regularity and steadiness of production. In the production of standardized articles, slack periods can be utilized to manufacture for stock with the assurance of sale in "boom" times.

7. Reduction of overhead charges resulting from saving in capital sunk in machinery of varying type; saving in

"idle-time" charge for machines, saving in testing finished products, saving in storage space.

8. Saving in time taken for assembling complex machinery when standard interchangeable parts are used.

9. Shorter times required for delivery.

From the standpoint of labour—

1. The increased regularity in production benefits the worker in ensuring continuity and steadiness of employment.

2. Increased individual production results in higher earnings.

The distributor also gains enormously from standardization—

1. The amount of capital tied up in carrying a wide range of stock-varieties is greatly reduced.

2. The business of both buying and selling is facilitated.

3. With standard lines of goods his turnover is more rapid.

4. A rapid turnover means elimination of waste from soiled stock and obsolete patterns; less stock depreciation and lower overhead charges.

5. His selling costs are reduced.

6. Unhealthy competition and price-cutting is largely abolished.

Nor are these benefits to the industrial and commercial community made at the expense of the consumer, since the consumer also reaps many advantages from specialization—

1. The economies in production and distribution result in lower selling prices.

2. Standardization tends to improve the average quality of the finished product.

3. The buyer of standardized goods is assured of getting what he orders.

4. When large-scale buying is done or contracts made on tenders based on standard specifications, the placing of the order is greatly facilitated.

5. Standardization facilitates the replacement of worn-out or defective parts of complicated machinery.

The advantages of standardized raw materials are sufficiently obvious. For each operation in production there is some type and size of machine which is better adapted to the purpose than any other. There is one best method of carrying out each industrial operation in the process of manufacturing. For the consumer's purpose there is also one best type and size of product.

There has been a marvellous growth of simplification and standardization in Europe since the war, in regard both to the number of standards established and in preparation, and also to the number of industries involved.

Before the war there was only one national standardizing body in Europe—The British Engineering Standards Association. Now such bodies are to be found in twenty European countries and there is probably not a country in Europe which is not carrying on, in some way or other, work in simplification and standardization.

In the United States the work of technical standardization is carried on separately from that of simplification. There are several hundred organized groups, including five national standardizing bodies, fifty-four Government bureaux, and one hundred and ninety-one trade and commercial associations all engaged in standardization work.

This enormous growth in standardization is due to many causes—the European industrial conditions after the war; the influence of simplification and standardization in the struggle for foreign markets; and the fact that in the rationalization of industry both these factors were regarded as of primary importance.

Germany and Great Britain are the two European countries most actively employed in the work of simplification and standardization. The work in Germany up to the present has been primarily dimensional in character, while that of Great Britain has proceeded along somewhat similar lines to that of the United States, though the rate

of progress has been slower in Great Britain than in either of these countries.

Great Britain was the pioneer in modern standardization. Sir Joseph Whitworth succeeded in establishing standard screw threads for bolts and nuts in the last quarter of the nineteenth century. In 1901 the first national standardizing body—the Engineering Standards Committee—was formed with eight members. In 1918 it was incorporated as the British Engineering Standards Association; and it has now about 500 sectional committees and sub-committees and over 2600 members—engineers and business men from all over the British Isles who give their services freely in this national work. The work of the Association not only covers the engineering and allied trades, but includes such diverse commodities as petroleum products, building materials, ships materials and fittings, while practically all the Portland cement manufactured in the country is made to the Association's specification.

The Association does not initiate standardization, but waits for an external demand; and only on the request of a representative trade, or technical organization, or a Government department will the Association act. The first step is the holding of a representative conference of all concerned, in order to ensure that there is a recognized want, and that the consensus of opinion is favourable to the work being carried out. When this is assured, the Association appoints a sectional committee, which carries out the work of fixing the standard. In some cases the sectional committee is representative of a whole industry, as in the case of the electrical committee, while other sectional committees, such as the non-ferrous metals committee, are representative of materials.

The other national standardizing bodies follow the British method of co-operation with more or less modification. The sectional committees, composed mainly of representatives of the various interested groups, deal with the technical decisions involved in the formulation of standards. All

these national bodies keep in touch, by exchanging information in regard to new projects, draft standards, and general tendencies in the respective countries.

An attempt was made in 1927 to establish a federation of all the national standardizing bodies, but the project was dropped. This result may have been partly due to national rivalry, but it is probable that the real barrier lay in the different national conceptions of standardization. Thus, while standardization on the Continent has dealt with components and interchangeability along highly technical lines, in Great Britain it has developed more along industrial lines, producing national specifications of quality and performance beneficial to the whole community.

In considering the work of standardizing bodies we must not forget that of the Central Government. Apart from its work of the legislative establishment of standards in weights and measures, in coinage, in purity of foods and drugs, etc., many Government departments carry on a positive work in this direction.

Standardization usually begins in the individual firm, which, recognizing its importance as a profit-earning policy, introduces standardized methods and types. The consumer, influenced by lower prices and improved service, endorses the policy by the increased demand for the standardized products. Competing firms follow on the same lines, and the movement spreads to the entire industry. So far, the movement has been dominated by trade interests —the interest of the consumer being considered only in so far as it is necessary to induce him to accept the standardized article. But to reach its highest efficiency the standardization must be not only "industrial" but national. It must be carried out by some central co-ordinating authority, representative of all the interests concerned, so as to confer the greatest possible benefit on the entire community.

British standardization, however, must go even further, since British industries rely mainly on foreign markets.

The B.E.S.A., the national standardizing authority, in its work emphasizes the foreign and Empire trade possibilities. In the reduction of steel telegraph poles from an almost infinite variety to four types, these types were made not only standards for England but for the Empire. The B.E.S.A. has also had the descriptions of existing British standards translated into foreign languages, so that they can be used by foreign purchasers, thus increasing the market for British goods.

Canada, Australia, New Zealand, and South Africa have all standardizing bodies which keep in close touch with the B.E.S.A. But something more than that is necessary. Imperial agreement on industrial standardization is required, whereby measures of co-ordination may be arranged.

It would be a mistake to imagine that standardization is equally applicable in all industries or that all countries give equal opportunities for its development. While British industries have had to buy most of the raw materials from abroad, and have, consequently, used it with a considerable degree of economy, American industries, on the contrary, have a vast background of almost unlimited natural resources, and their raw materials come from local supplies. There was, therefore, a greater tendency towards industrial waste, and consequently greater scope for improvement than in England. America, again, sells 90 per cent of her manufactures in the home market; while 75 per cent of British products are sold in foreign markets of varying requirements and tastes. While America controls her home market, Britain has to face in foreign markets increasing native competition. As this tendency will increase rather than diminish in the future, Britain must concentrate on a high quality of product while catering for local variations in demand.

But while the slow progress of standardization in this country is to some extent explained by the dependence on foreign trade, there is an ingrained British characteristic

which resists anything that restricts individuality or favours uniformity. This is, in some cases, undoubtedly a source of strength, but if carried to extremes it may be a source of weakness, and in industrial affairs may result in waste and inefficiency.

Standardization, of course, has its limitations. It may be approved where it aims at the conservation of materials, and the prevention of waste; where it makes toil easier, and simplifies the mechanics of life. Standardization of the rigid and narrow type is not possible where a measure of variety is required to meet the varying requirements of our foreign markets. But, between narrow standardization on the one hand and a limitless variety on the other, there is much preventable waste. Economy is essential to industry, particularly at the present time. A large measure of economy is attainable through standardization, both in industry and in business. Among the leading industrialists, the principles and benefits of standardization are generally recognized. But the wide opportunities of applying those principles are not fully realized in either industry or business.

This fact was recognized by the Balfour Committee, who considered that the urgent danger of the present situation was not the likelihood of a too rapid and indiscriminate adoption of standardized methods, but was, rather, the inertia of the trades concerned, and their passive resistance to changes in customary practice.

CHAPTER XV

INDUSTRIAL TRAINING, TECHNICAL EDUCATION, AND RESEARCH

Industrial Training

A great deal of scientific study is devoted to the organization and control of factories, works, and offices. Scientific control in an industry begins even before the location of the enterprise is selected, continuing throughout the planning and lay-out of the plant in the installation of well-directed systems of lighting and ventilation, properly arranged systems of machines and office apparatus, and so on. Engineers and chemists keep constant check on the productive processes and aim always at their improvement.

Yet efficiency in industrial output is not a mere question of volume, but depends essentially upon quality. Quality of production is affected by factors such as industrial recruitment, workshop training, technical education, scientific research, industrial art, and standardization. The importance of the first three may be considered, since they directly influence the worker's capacity and skill to produce high-grade work under commercial conditions.

A worker's skill may be developed in various ways, chiefly by the definite training of apprenticeship. Another way, though not always realized as such, is by the subconscious absorption of that knowledge and experience which permeates the 'atmosphere' where an industry is highly localized, and generation after generation of workers are born and brought up in the same industrial environment.[1] The old traditional skill which was the result of the creation, preservation, and transmission of traditional craftsmanship in the apprentice system is now being rapidly displaced by modern industrial methods of production.

[1] Committee on Industry and Trade, *Factors in Industrial and Commercial Efficiency*, p. 18.

It is not difficult to point out where the apprenticeship system is failing. Apprenticeship belongs, more than most industrial features, to the small-scale industry; and in the present age, the size of industry, the process of subdivision of labour, and the population itself are outgrowing the institution of apprenticeship. There is a tendency to substitute for the traditional form of trade apprenticeship a shorter and more specialized form of training. Furthermore, the attitude of trade unionism towards the limitation of the numbers of apprentices in certain trades, together with the importance attached to the right of practising certain trades, has unconsciously affected adversely the institution of apprenticeship itself.

Under modern industrial conditions in Great Britain there is an increasing need for the application of greater technical knowledge than was necessary under the industrial conditions of twenty-five years ago. The relative range and potency of the apprentice system in any trade, but more especially in engineering, have tended to decrease as compared with the more definite and concentrated processes of college education and specialized workshop training. The increasing complexity of modern production has limited the means which it is practicable to employ in order to produce the requisite number of trained tradesmen.

The training provided by various classes of schools and colleges and made use of by young workers, either before entry into works or concurrently with workshop training, has become more and more important.

One of the greatest assets of a country which depends upon the export of manufactured commodities is the skill of its workers. The tendency towards scientific control in modern management emphasizes the responsibility for and the value of training. Thus, for Great Britain the importance of the subject of industrial training is obvious.

The skill and intelligence of the workers are influential factors in the performance of responsible work; and even in many routine industrial and commercial employments

the application of a certain amount of intelligence is required. Only where operations are of an automatic and thoroughly fool-proof character is the demand upon a worker's intelligence negligible.

Furthermore, in this country it is now generally admitted that the original formulations of scientific management, particularly the theories of Dr. Taylor, cannot be applied successfully to industry as a whole, since it does not always hold in practice that by reducing all manufacturing operations to elementary simplicity the operator himself becomes less and less essential. "The distinction between the Taylorian theory of scientific management and training (i.e. the new aspect of industrial training) is that under the Taylorian system the object is the product, while under the system of industrial training the object is the producer. . . . It is no mere sentimental or humanistic utterance to say that the best product finally can only come from the best producer." [1]

The foundations of economic prosperity lie in the character, skill, and intelligence of the workers. Well-directed energy is required from the lowest industrial human unit to the highest, and this can only come from the training of ability to make it adaptable to the work that has to be performed.[2]

The importance of adequate training, technical education, and a more scientific method of selection and recruitment cannot be exaggerated. A brief survey of industrial training, the facilities available for technical education, and the problem of recruitment may now be attempted, in order that the material brought together may be of assistance in arriving at clearer views on this important question.

General Position of Apprenticeship System within Present Industrial Structure

The institution of apprenticeship goes back for many hundreds of years. In Chapter I it was shown that the

[1] J. Lee, *Industrial Administration*, p. 70.
[2] B. F. Shields, *The Evolution of Industrial Organization*, p. 256.

apprentice system was the most typical and instructive feature of the guild structure of industrial life. Hence, its existence in this country is more than five hundred years old. The character of the apprentice system even to-day is largely traditional.

Apprenticeship in the present generation suffered a serious set-back during the war years, and because of the conditions which prevailed there arose a decided tendency to restrict the supply of apprentices. The post-war industrial depression tended further to make more difficult the problems of apprenticeship. In certain branches of industry there is a marked tendency to turn to alternative methods of recruitment and training; while in addition the stricter basis of apprenticeship by indenture is being largely replaced by something less formal in character.

The more important industries utilizing the institution of apprenticeship to the greatest extent at present are as follows—

Shipbuilding and engineering
Building trades
Woodworking and allied trades
Vehicle building
Heating and domestic engineering
Electrical contracting
Boot- and shoe-making and repairing
Printing
Pottery
Cooperage

and certain of the distributive trades.

In the heavy industries, such as coal-mining, iron and steel, heavy chemicals, the apprentice system is used only with respect to workers employed on maintenance work which requires a proportion of skilled tradesmen.

It may be stated that, as a general rule, employers as an organized body do not concern themselves in questions regarding apprenticeship policies. All considerations with regard to apprenticeship problems are left to the individual

member who may define his attitude according to his particular needs and conditions. In most instances employers' organizations draw up model indentures for the guidance as well as the protection of the individual employer; they do, however, agree to the main ordinances of trade unions regarding apprenticeships.

Trade unions, on the other hand, take an active interest in the principles of apprenticeship. Their rules specify the length, the age limits, the ratio of apprentices to journeymen, the wages paid, and many other points regarding an apprenticeship to a particular trade. All the rules may or may not be recognized by the employers; they may be embodied in joint agreements or they may be acknowledged without an agreement. As a general rule there is some sort of co-operation between employers, trade unions, and local technical educational authorities with regard to the training of apprentices.

Many of the Joint Industrial Councils and practically all trade boards concern themselves especially with questions regarding apprenticeships. Trade boards, under the Ministry of Labour, may specify the maximum wage and the conditions of apprenticeship for particular trades; and they usually issue a model form of indenture for the trades concerned.

Apprenticeship

Apprenticeship may be defined under the following categories—

I. Apprenticeship by legal indenture.

II. Apprenticeship by simple written agreement.

III. Apprenticeship by oral agreement.

The three categories are agreements on the part of the employer and apprentice to train and serve respectively; but, as their descriptions imply, the obligations contained become less easy to enforce and less binding in the order named. All apprenticeship agreements specify the length of time to be served, the wages for each of the years, and,

in some cases, the technical classes which the apprentice will attend.

The legal indenture apprenticeship system belongs more to the older-established industries, and for traditional and other reasons some firms adhere to the old system. The greater number of industries has, however, substituted the types of apprenticeship under II and III which give more elasticity and apparent freedom from legal restraint. Economically, the results of either choice are not very different. The tendency of apprenticeship agreements to assume something of a loose and indefinite arrangement is a consequence of the typical form of industry giving way to large-scale machine production and subdivision of occupations, thus altering the former position of the skilled worker, as well as the whole character of productive methods.

The number of years of apprenticeship varies in different trades from seven to two years, the predominant period being five years. This is based upon the time necessary to train the apprentice in a trade, as well as being governed by the school-leaving age. The most common age for beginning is from 14½ to 16, and only in a few special cases is it 17 or more.

The low wages given to apprentices during the first years of apprenticeship are based on the fact that the employer necessarily gives more in training than he receives in service from the apprentice. During the latter years of the apprenticeship the wages remain comparatively low in order that the employer receives back, in greater or less part, some equivalent of the time and inconvenience that the apprentice cost him during the early years.

The employer may fulfil his part of the relationship by training the apprentice in one or more of several ways. The traditional method is to put the apprentice with a journeyman; he may work alongside or under the direct supervision of the journeyman, who by personal contact imparts to the youth some of his skill. Under modern conditions two defects in this arrangement are apparent:

shorter hours and increased subdivision of operations make it difficult and expensive for journeymen to allocate the necessary time to give apprentices an all-round training. And because most of the work of production is done under various bonus schemes, and in many cases under piece rates, a journeyman is not inclined to risk any possible financial loss by giving the necessary time to the apprentice's training, unless and until the apprentice becomes an additional productive unit for the benefit of the journeyman.

In different firms apprentices are grouped together directly under the control of the foreman, or of a specially qualified foreman or journeyman exclusively charged with the duty of teaching apprentices. In large modern industrial undertakings there is a separate works school where all apprentices receive systematic instruction under the firm's own qualified instructors. The latter method, however, is only possible in very large-scale plants.[1]

The above outline gives, broadly, the general position of the trade apprentice in Great Britain, whatever may be the form of agreement under which he is employed. There is a higher grade of apprentice called a "pupil"; a grading which involves the giving of a wider training, including a little experience of different trades, in order to equip the pupil for an ultimate supervisory post. Another subdivision consists of the student-apprentice class. In some cases the student-apprentice is identified with the pupil, but in the majority of instances he is a trade apprentice attending for a definite period (usually one full year) the trade classes provided by the local education authority. Finally, there is the class trained under Government control, i.e. the R.A.F. aircraft apprentices and the Royal Dockyard (trade) apprentices. The methods employed to train the increasing number of R.A.F. aircraft apprentices are consistent with the vital importance of the work of the service; and the technical and educational standards of ability attained by the individual aircraftsman are higher than those of most tradesmen in this country.

[1] See *Factors in Industrial and Commercial Efficiency*, p. 142.

Learners

During the recent years of trade depression, although the supply of youths has been more than adequate, the number of apprentices has been greatly restricted. This is due partly to the reluctance of employers to enrol more apprentices than they needed, and partly to the unwillingness of boys (or of their parents) to consider an industrial career which entails so many years of practically unremunerative employment. The latter cause for the restriction of the number of apprentices, in view of the present abnormal condition of industrial livelihoods, is not difficult to understand. The ratio between wages in non-apprenticed employment in certain trades and wages commonly offered to apprentices is greater than that of pre-war years. Widespread unemployment, uncertainty of future conditions, and the consequent dependence of many families on the earnings of every member render both boys and their parents liable to choose the relatively higher immediate wages of non-apprenticed employment.

Thus, the prevailing reluctance of parents to apprentice their boys to skilled trades on account of the raised cost of living, together with the development of large-scale machine production, has resulted in the emergence of a new class of industrial youths called "learners." The word "learner" means a juvenile worker not being apprenticed who is specially engaged for a recognized period of training, and is provided by the employer with definite facilities for learning a branch or process of manufacturing. The rate of wages paid varies with the juvenile's status. The obligation to provide training ranges from a requirement that definite training shall be given in prescribed operations to a general requirement that the youth shall be provided with facilities for learning the trade. If the required degree of training is not given then the employer is legally bound to pay a higher rate of wage; in some cases, it is equivalent to that of the ordinary adult

worker, in others it is an intermediate rate between the learner's and the adult rate.[1] In any case boys can earn much higher immediate wages in this type of employment than in apprenticed employment.

There is one aspect of "learnership" which may be defined as synonymous with a low grade of apprenticeship, namely, that which exists in some industries where no form of recruitment is used other than through the avenue of "learnership." The cotton trade recruits all skilled operatives from "learners"; other industries use the "learner" system to train semi-skilled workers (such as machine operators).

The learner enters employment as soon as possible after leaving elementary school; but in heavy industries he is precluded from entry until he is physically capable of doing the work. The period of learnership is used frequently as a probationary period, and in most cases it is a short one, based on the time required to become proficient in the trade. A common method is to give some training to a group of learners and then leave them to acquire the additional training necessary through observation and practice.

In the past, before modern methods of production had developed into a minute subdivision of occupations, the system of apprenticeship and of journeymen guaranteed to some extent the proficiency of future workers. The facilities for workshop training under the present conditions have, in this respect, however, been retrogressive.

Technical Education

In industry a large proportion of unskilled and semi-skilled workers require, generally speaking, no technical education, and very few of these voluntarily seek any sort of technical training or instruction. Of the remaining persons who do require some provision to be made for their education, apprentices of different grades and learners

[1] *Factors in Industrial and Commercial Efficiency*, p. 137.

comprise one section. Tradesmen (including leading hands), foremen, draughtsmen, and others who, through the technical training and instruction they have already received, have attained a certain measure of responsibility in industry, require facilities for instruction in the latest advances in technical processes in order to put their knowledge to practical advantage.

The encouragement of training in basic principles is very variable among different firms. While the possession of technical qualifications is not stressed as being particularly necessary in the greater proportion of recruits to engineering industries, it is different with regard to the higher posts. These demand and must be filled by well-trained engineers, that is, with men whose theoretical training, combined with shops and office experience, qualifies them to be described as professional engineers, whether in an administrative, executive, technical, or commercial capacity.

There are, therefore, two aspects to the problem of technical training: (1) The facilities and encouragement to be given to trades apprentices, operatives, and others to take up some appropriate form of technical instruction in evening classes; whether these facilities are provided within the works or given by the local educational authority; (2) the arrangements whereby a suitable supply of trained engineers may be maintained for the purposes of recruitment to the higher technical staff.

It is recognized that of the trade apprentices and others who enter the industrial field, the great majority will never rise beyond the rank of operatives or skilled workmen, nevertheless the facilities for technical education provided should contain an adequate provision for those who, by virtue of their ability, character, and capacity, desire to become more than mere skilled workers. Broadly speaking, and taking a long period view, engineering training for most youths is a long and arduous process, involving tiring physical work in the day-time, theoretical work in the evenings, and low wages for a great number of years.

The greater number of capable young men are often prevented by economic and industrial circumstances from receiving an adequate return for the amount of time and labour expended in attaining comparatively high standards of technical qualifications in conjunction with their workshop training and experience. Nevertheless competition remains very keen.

Training and technical education are admittedly not ends in themselves, and it is only natural that the youth in engineering should be keenly interested in the types and prospects of future employment which may be available to him at a later stage. Engineering is not a definite sphere such as medicine, and the youth who combines the correct course of technical training with the practical side may eventually secure a firm footing in one of the following fields of activity in engineering—

Design. Drawing office. Erection and maintenance of plant. Research and experimental. Laboratory. Production control. Production equipment design. Commercial.	All requiring highly-trained engineers.

In the engineering industry, men now holding positions as foremen, draughtsmen, managers, technicians, and, in many instances, some of the highest administrators commenced their engineering career as trades apprentices.

At the present time the desire for advancement among engineering and other apprentices is shown by the figures of recent examination results or the junior membership numbers of any technical institution. For the academic year 1930–31, 914 students obtained Bachelor degrees in the Faculty of Applied Science and Technology from British Universities; 327 apprentices took the Higher National

Certificate, and 974 the Ordinary National Certificate in Mechanical Engineering.

Employers for the most part stress the desirability of apprentices supplementing their training by attending technical classes, in view of the growing inadequacy of modern workshop organization to provide within itself the complete training necessary for skilled employment. A considerable proportion of firms show a positive recognition of this fact by paying the whole or part of apprentices' class fees, by giving preference to youths who have received or are receiving technical instruction, and in some cases by making attendance at classes compulsory.

Few firms, however, allow time off during working hours for classes. In consequence, the ever-increasing facilities provided by technical institutes and colleges for supplementing training are not always, nor very widely, used by all apprentices or for the full term of apprenticeship. Two factors influence the reluctance of apprentices to keep up a systematic attendance at evening classes; one is the natural fatigue arising from a full day's work, the other the competition of other immediate attractions.

For this reason, or for other reasons due to the locality or conditions of work, many firms have lately devised technical instruction schemes to suit their special needs and with the ultimate view of promoting industrial efficiency. These schemes take the form of incorporating a definite educational system within the works and as part of the apprentice's period of training. Usually the technical instruction is closely interlinked with a factory training appropriate to the nature of the firm's activities.

Technical Schools and Colleges

With regard to technical colleges, institutes, or schools generally, two considerations present themselves. On one hand there is the provision necessary for instruction in the subjects relating to the application of science and technology in the various industries. This provision includes a

standard curriculum of fundamental matter, such as mathematics, drawing, and certain sciences, as well as instructions regarding methods, functions of appliances, purpose and effects of processes and qualities of materials used in the industry. Instruction must be given in design, in experimental work in laboratories, and also, where necessary, in matters pertaining to the organization of business, whether as regards one particular industry or industry considered collectively.

On the other hand, technical-school authorities may bear in mind the requirements of certain industries in respect to actual operations performed within an industry for the purpose of perfecting the individual skill of each student. This provision necessitates, in many cases, the installation and considerable use of machines for actual production. For example, a technical institute situated in, and providing for the educational requirements of, an industrial centre for textile manufactures will require looms and other textile machines under its control. Special attention must always be given by technical schools to the question of manipulative training for students who are apprentice plumbers, photo engravers, machinists or other workers desiring to possess a high degree of individual skill with hand tools, or in working individually with processes.

Under the present system the technical schools do not, as a general rule, cater for the perfection of personal craftsmanship, implying therefore that such is not their normal function. It may be said that the character of present-day technical courses in Great Britain varies from one part of the country to another, depending not only upon the intrinsic nature of the industries localized in one particular area but on the degree of their dependence upon the application of science. The character of technical schools is influenced also by the traditional character of the educational staff and the relationship existing between the surrounding industries and the educational authority, the financial resources available, the limits of students' time,

and, in general, upon the rulings of the Governmental Education Department.

Few technical schools or colleges specialize in only one branch of applied science and technology. The industries in relation to which instruction is offered constitute the main supply of students for the evening classes. Thus, the courses in mechanical engineering conducted by a college in a shipbuilding centre would be strongly biased towards marine engineering. The tendency to introduce both pure and applied science becomes much more distinct if the industries are those which depend to any extent on the development and progress of scientific knowledge.

For example, the scientific bias is not so clearly defined in the courses connected with the textile or building trades as it is in connection with engineering, industrial chemistry, or metallurgy. In the latter, most of the actual teaching is by University men, graduated in either applied or pure science. In the former, the greater part of the teaching staff is made up of practical men whose knowledge of the industry in connection with which they teach is, as a rule, detailed and comprehensive, but whose actual teaching keeps closely to the practical side at the expense of the academic. As regards the future of industrial education a more scientific treatment will have to be coupled with practical knowledge in almost every branch of industry owing to the ever-increasing application of scientific research to the problems of industry as a whole.

Many of the authorities who encourage evening study make adequate provision for it by schemes of graded study which are organized to occupy from three to five years. These schemes may be divided into different grades, the junior course offering instruction in fundamental subjects, the senior providing specialized instruction to correspond with the principal local industries. Both categories have a technical and a commercial division. In certain technical colleges, students may, after completing the senior course, proceed to more highly-specialized study.

At present technical schools may be divided into two classes of which one comprises the large-scale organizations situated in important industrial centres, and the other includes both small and medium-sized organizations. The large technical organizations are never confined to evening work. Most of them include both day and evening instruction covering a wide range of educational and vocational subjects. Groups of related subjects are usually arranged as separate departments, such as Mechanical Engineering, Textile, Electrical Engineering, Building, Commerce, Chemistry, Naval Architecture, etc. During the day-time under the same organization are embraced Day Technical courses, Day Technical Intermediate (known as Junior Technical), and other full-time or part-time courses of vocational instruction.

Where advanced technical instruction, comprehensive in scope and character, is offered, there may develop a working arrangement between the technical colleges and universities; but these arrangements are not the result of systematic planning. Most universities try to provide within their own precincts adequate provision for full-time students in various branches of applied science and technology. Arrangements do hold, however, in certain university towns whereby the technical college provides a faculty for the university. In non-university towns some technical colleges are important educational centres, and, to a large extent, the London University external examinations meet the needs of students, which should normally have been served by the nearest university.

A few instances of university-technical college connections may be mentioned. Full-time technical students may qualify for degrees in applied science at the Municipal College of Technology, Manchester, and at the Merchant Venturers Technical College, Bristol. Queen's University, Belfast, is a notable example. Either full-time or evening students may qualify for degrees in Applied Science in the Municipal College of Technology. The former take a

three-year course; while the latter take a five-year course concurrent with day-time employment in some technical or commercial branch of the subject studied. Sheffield University makes provision within its Department of Applied Science for those technical students who are able to take only evening classes. Leeds University gives certain classes in technology to part-time students, but in other branches of technology the instruction is supplied by the Municipal Technical School.

In Glasgow the Royal Technical College is affiliated to the University of Glasgow and receives grants from the University Grants Committee.

National Certificate

Before 1920 engineering apprentices had little guidance as to the most suitable subjects for evening-class study. It is true that public examination authorities included in their list of subjects for examination many that formed part of their engineering course. But these were individual subjects; each subject was dealt with in several grades and there was nothing in the nature of a comprehensive course. It was therefore difficult to gauge the exact theoretical capabilities of individual apprentices owing to the number and varied nature of the certificates presented. In important industrial areas, however, the technical colleges maintained grouped courses of their own in which they examined and awarded certificates or diplomas.

In an effort to standardize the prevailing variation of courses the Board of Education, in close co-operation with the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Institute of Chemistry, and the Institution of Naval Architects, issued a scheme which is now known as the National Certificate Scheme. This was based upon the experience and the average standard of the technical colleges and of their grouped courses.

In brief outline the scheme arranges for technical colleges to organize local three-year courses of their fundamental industrial subjects, which shall qualify successful students for an ordinary National Certificate in mechanical or electrical engineering. The technical college, in each case, may exert a certain amount of influence over the syllabus, but the following is a representative course of subjects—[1]

1st Year:

MATHEMATICS.
PRACTICAL GEOMETRY.
MACHINE DRAWING.
2 hours each per week.

2nd Year:

MATHEMATICS.
MACHINE DRAWING.
MECHANICS AND GEOMETRY.
2 hours each per week.

3rd Year:

MATHEMATICS.
MACHINE CONSTRUCTION.
MECHANICS AND HEAT ENGINES.
2 hours each per week.

The value of the certificate is obvious, since the standard is unified by a central control; and hence an employer is assured that any applicant holding a National Certificate has attended regularly a related course in engineering for at least three years, has worked systematically at the homework set, and has satisfied the examiners each year.

In 1931, out of 1644 candidates for the National Certificate (Ordinary) 59 per cent were successful.

The Higher National Certificate is an evidence that the holder has specialized for a further two years in those subjects directly connected with his branch of engineering, and hence suggests his possession of the ability to do more

[1] Ordinary National Certificate Course (Mech. Engineering) provided by Municipal College of Technology, Belfast.

advanced work. The subjects taken and in which he is examined each year may be—[1]

4th Year:

HEAT ENGINES (Theory and Laboratory).
MACHINE DESIGN.
MATHEMATICS.

5th Year:

THEORY OF MACHINES AND STRENGTH OF MATERIALS.
MECHANICAL ENGINEERING (LABORATORY-PRACTICE).
MATHEMATICS.
2 hours each per week for both years.

SCHEMES OF TRAINING

From the standpoint of educational facilities the position of those recruits to the engineering industry who may ultimately become technical, executive staff, designers, or other forms of professional engineer, may now be considered. Irrespective of ability and character these recruits may be divided into three possible categories—

I. Those who require a living wage as soon as possible.
II. Those who can just afford a certain expenditure for a full-time college course.
III. Those to whom money considerations are not so important.

The facilities available for blending theory and practice in different proportions and at different stages of training are numerous. Basing the requirements of a youth who possesses an average natural aptitude on the assumption that his preliminary school education is up to matriculation standard, and that he falls under one of the above three categories as regards financial resources, it may be suggested that one of the following will provide a possible course of training.

(*a*) Three years to be spent in a recognized technical college in taking a full-time engineering course for either a

[1] Higher National Certificate Course provided by Municipal College of Technology, Belfast.

degree or a diploma. This will be followed by three years spent in a first-class engineering works as a pupil or student apprentice.

Or

(*b*) A full apprenticeship to be entered upon in a reputable engineering works supplemented by evening or part-time technical classes preparing for the Higher National Certificate. If possible the supplementary evening classes should be those of a recognized course for a University degree instead of the Higher National Certificate course. It is understood, however, that only in very few industrial centres does the technical college provide a faculty for the university. For a certain number of apprentices the opportunity may occur to follow up their apprenticeship by a full-time course at a recognized technical college preparing for a degree.

Or

(*c*) By spending alternate periods of six months in the technical college or university and in the works. The winter term to be devoted to study and the summer term to practical work. The period of training will exceed the duration of either (*a*) or (*b*). This system, called the "Sandwich" system, is freely made use of by engineering apprentices in the west of Scotland and in different parts of England.

As regards scholarships, nearly all education authorities provide either full-time or part-time scholarships to enable selected students to enter diploma or degree courses in the higher technical colleges or Universities. For trade apprentices, or other young persons with experience of trade or industry, several arrangements are in existence whereby selected candidates may obtain systematic instruction in the principles of science and art as applied to their trades, without monetary loss. A maintenance allowance together with examination fees are paid by the education authority granting the scholarship. For example,

the Ministry of Education for Northern Ireland pays each student a maintenance allowance equivalent to the wages, up to a maximum of 27s. per week, which he would have been in receipt of had he continued in his employment; and in certain cases an additional sum to cover travelling expenses.

There is very little provision made in Great Britain for the technical education of workmen or men holding positions of minor responsibility in works. The improvements in the class of teacher, the higher academic qualifications of most of the teachers and the new significance of craftsmanship in the organization of industry have led to a preponderance of professional training to the exclusion of artisan training.

Training and Technical Education in Other Countries

It is not possible to make a proper comparison between the British system of technical education and industrial training and those of other countries. In Great Britain it is left to the individual to make the voluntary effort to find suitable educational courses for himself and to make systematic use of them or not according to his own inclinations. The few notes brought together with regard to foreign systems do mark the fact that while continued education in Great Britain remains a personal matter for each individual, on the Continent it is developed to a great extent on a compulsory basis.

Russia. Engineers of all grades in Russia are trained practically and technically according to the co-operative plan. The responsibility of training rests with the industries, which, being state-controlled, function as part of the government administration; hence, both production and education become equal responsibilities. The plan requires elaborate administrative machinery and great centralization

of control. Engineering education is, however, considered to be a very important item of the plans laid down for shaping and controlling the industrial programme of Soviet Russia. Subject to the Planning Commission of Soviet Russia are the People's Commissariats, which comprise financial, agricultural, economic, educational, trade, transport, foreign, and domestic interests. The responsibilities of industry in production and technical education come under the People's Commissariat of Economy. All industrial groups are included. Co-ordinate with these groups are two technical commissions, the Board of Research Institutes and the Supreme Committee of Engineering Education, which advise and regulate in matters pertaining to industrial research and education.

Final authority is in the hands of political bodies, at the head of which stands the Conference of the Soviets. To ensure intelligent control in industrial and scientific matters a powerful executive body, the State Scientific Council, is organized under the People's Commissariat of Education. This council comprises members from the trade unions, the army, the navy, engineering societies, the State-planning Commission, and various Commissariats from the U.S.S.R. and the federated autonomous republics. This council plans the education for the whole State and in all fields of activity. It determines the syllabus for all standards of education, theoretical and practical, and directs all research work. It specifies the quota of students and sets the standard required for examinations and promotions. It appoints teachers and professors and selects the textbooks to be used. Finally, it co-ordinates the educational and scientific work of the whole industrial structure.

Educational specialization begins at the early age of eight years, when the children enter the factory schools. For seven years the children are trained specially for industrial work, by giving them an actual contact with factories and workshops.

After seven years in the factory schools the children

enter one of two courses. They may be passed on into a three-year course in a technical college, with the ultimate view of being trained as engineers or specialists; or they may enter a three-year course in some particular works, from which they leave as skilled manual workers. From the technical school, a proportion of the youths may qualify as technicians of medium attainments and be absorbed into the industrial organization, and a proportion will continue higher technical studies after an apprenticeship in industry. Those selected for the latter become engineers and specialists, and they consist of those youths who are found to possess superior mental gifts. Another selection takes place after three years for technical teachers and research workers. These are given a further two years' course in a suitable institute, which is equivalent to a British university degree course.

To prevent rigidity or exclusiveness a separate system of education called the Workers' Faculties is devised. This enables those, who by circumstances have been prevented from taking advantage of the State-planned courses, to reach the higher levels of education. After three years of intensive instruction and study they are able to enter the higher technical schools.

Each industry maintains a complete set of standard schools from the seven-year factory school to the higher institute (or university equivalent). In addition, each industry, of its own accord, supplements the regular educational sequence by an elaborate system of part-time schools for all persons in the works. All educational work is co-ordinated by the supreme committee of engineering education; and all schools and colleges operate under a centralized control.

Two important aspects of this system stand out: Economic conditions, which in theory are supposed to be stabilized in Russia, do not interfere with a student's training and educational progress; and every possible social distinction between manual and intellectual work is

eliminated. In addition, the activities of the student are not his private affair; they are part of his duty to the State. All competition between students must be based distinctly on the ultimate service to the Soviet and without any reference whatever to private progress. Education and means of subsistence are provided free by the State, which both defines and controls them.

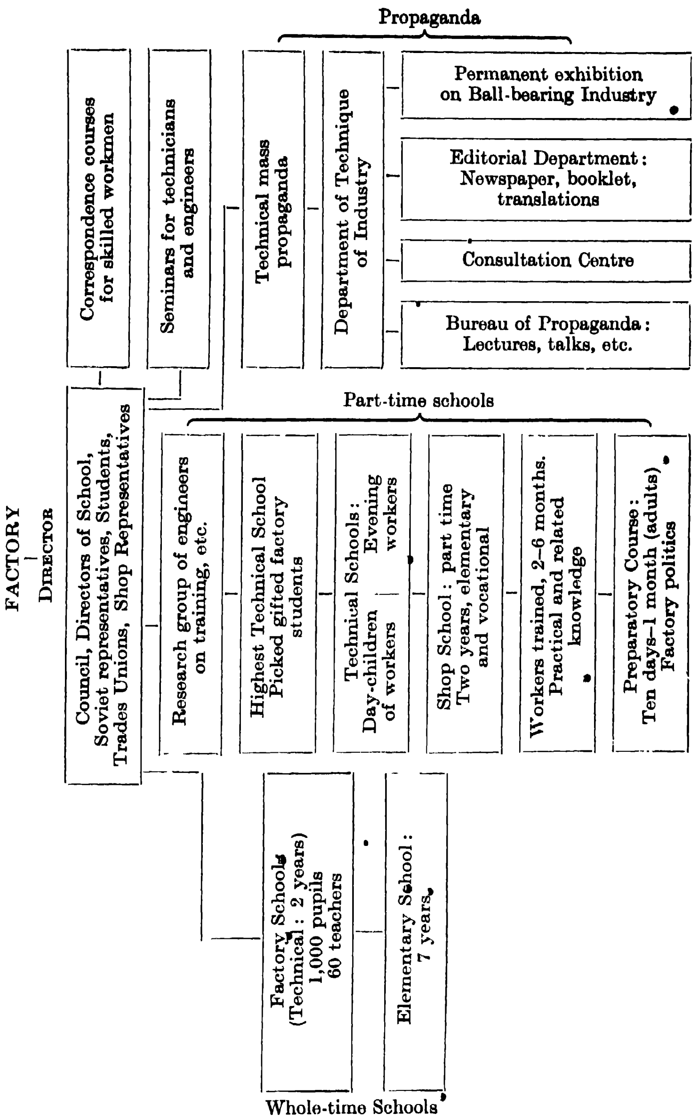
"The first state factory for the manufacture of ball bearings in Russia, which opened in January, 1932, has established a complex system of factory schools. Four months before the opening of the factory there were already over 1000 pupils undergoing training in the whole-time technical school."[1] The chart on page 479 shows the school organization.

Germany. Germany, during the pre-war years, established elaborate and scientifically planned technical institutions to aid her industrial and commercial development. Technical education in Germany is controlled in each state by its own government and makes provision for the systematic training of all grades of industrial workers. The State is assisted by an advisory board of various educational and industrial experts called the National Industrial Bureau. Questions relating to school buildings, courses of study, encouragement of industrial education, and training of teachers come within the scope of the latter.

There is a close relationship between industry and technical education in Germany, and in very few countries is the value of the skilled and scientifically-trained employee more fully realized as an industrial asset. The recent economic advance in Germany is largely due to a well-planned system of technical and commercial education.

Compulsory measures play an important part in determining the normal progress in the efficiency of technical classes. In most German states all persons are compelled to attend continuation classes from the ages of 14 to 18,

[1] H. J. Welch and G. H. Miles, *Industrial Psychology in Practice*, p. 237.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Permanent exhibition on Ball-bearing Industry
Editorial Department: Newspaper, booklet, translations
Consultation Centre
Bureau of Propaganda: Lectures, talks, etc.
Part-time schools
Research group of engineers on training, etc.
Highest Technical School Picked gifted factory students
Technical Schools: Day-children of workers — Evening workers
Shop School: part time Two years, elementary and vocational
Workers trained, 2–6 months. Practical and related knowledge
Preparatory Course: Ten days–1 month (adults) Factory politics
Factory Schools (Technical: 2 years) 1,000 pupils 60 teachers
Elementary School: 7 years
Whole-time Schools

Fig. 40

for four to eight hours per week, with the exception of those already in attendance at higher schools. In the majority of cases this instruction is given in the day-time.

There are three types of industrial education, viz. the lower schools, the middle schools, and the higher technical schools and universities. In the first the instruction given is of a practical trade nature, and is organized generally on vocational lines, but in addition, these schools provide skilled and unskilled workers, and those not yet engaged in industry, with an adequate and appropriate technical education. The middle schools provide for those workers who hold comparatively responsible positions in industry by giving them instruction in the latest advances in industrial processes and by augmenting their technical attainments generally.

The most modern system of training industrial apprentices is the "Deutsche Institut für technische Arbeitsschulung." Under this system youths from 15 to 18 years of age are drafted into self-contained little works, each representing some section of the main industries. They become shareholders in these little plants from the day of their entry. Their progress is assessed by means of a card system, each receiving a card for particular jobs on which will be recorded the time taken by each individual to complete the work. On the card is also set out the time taken by a skilled worker for the same work, so that the apprentice may aim at acquiring daily increasing efficiency. Curves of output are an important feature in the success of this scheme, since each apprentice is enabled to follow his particular part in the success of the works. During a three-years' course apprentices pass through every department—and thus when they leave they have acquired an understanding of industry as a complete entity, with a developed interest in their work in industry.[1]

With regard to the technical colleges and the scientific

[1] H. J. Welch and G. H. Miles. *Industrial Psychology in Practice*. p. 236.

faculties of the universities, students are given every encouragement to engage in research and the most modern scientific studies; and the higher educational system has few parallels as an "advance-guard of technical progress" throughout the industrial world. On the other hand, the higher scientific instruction available in Great Britain to evening students, apprentices, and others attending part-time classes are less freely provided for a corresponding class in Germany. Such students who desire to take advantage of the scientific faculties of universities are expected to abandon their employment in order to devote full time to study.

There is, however, a change in this respect in recent years, judging from the increased establishment of evening classes in connection with continuation and engineering schools in Germany.

United States of America. Many of the States in the U.S.A. have made attendance at part-time continuation schools compulsory for persons between 14 and 18 years of age. The Federal Board of Vocational Education, formed after the passing of the Smith-Hughes Act in 1917, promotes vocational education in industry, trades, and agriculture, prepares teachers of vocational subjects, makes appropriation of money, and regulates its expenditure. It works on the principle of subsidizing, dollar for dollar, approved programmes of work formulated by the State authorities. Industrial enterprises do not, however, depend solely upon the State to provide the means for industrial education. Many industries establish and maintain trade courses within their plants and in special schools outside.

The American Federation of Labour, in stressing the need for a system which would develop the labour of the people and bring every worker nearer the limits of human efficiency by giving him an interest in his work, advocated the widespread establishment of schools in which pupils of 14 to 16 years of age could obtain a short but intensive apprenticeship by receiving instruction in the processes and

practical details of particular trades as well as the scientific principles upon which the processes are based. The evening schools correspond to the technical colleges in Great Britain and Ireland in that they provide suitable courses for those persons who are engaged in industrial and commercial pursuits during the day.

In addition to these, the majority of important firms maintain their own schools for the purposes of training their apprentices in the manufacturing operations and related theory of the industry concerned. Where the firm does not organize and administer a system of training and instruction within the works, co-operative schools, working under a co-operative agreement with the firm, instruct the apprentices and other employees. Schools operating under philanthropic auspices are intended primarily to give an opportunity to those persons who would otherwise remain labourers and unskilled workers to raise themselves socially.[1]

The incentive for a worker to take advantage of opportunities to uplift himself is very great. There is a widespread and remarkable desire for education and for a greater development of intellectual capacity among all classes in the U.S.A. Even industrial workers who cannot advance much further themselves attempt to secure the best possible educational opportunities for their children. As a consequence, the universities and the higher schools in America cannot cope with the number of applicants for admission. In addition, the development of commercial education is very remarkable in American universities, and coincident with this development, business schools outside the universities have sprung up all over the country to cater for the great demand for commercial training.[2]

Recruitment

The predominant factor in maintaining the usefulness of the apprentice system and other methods of training is

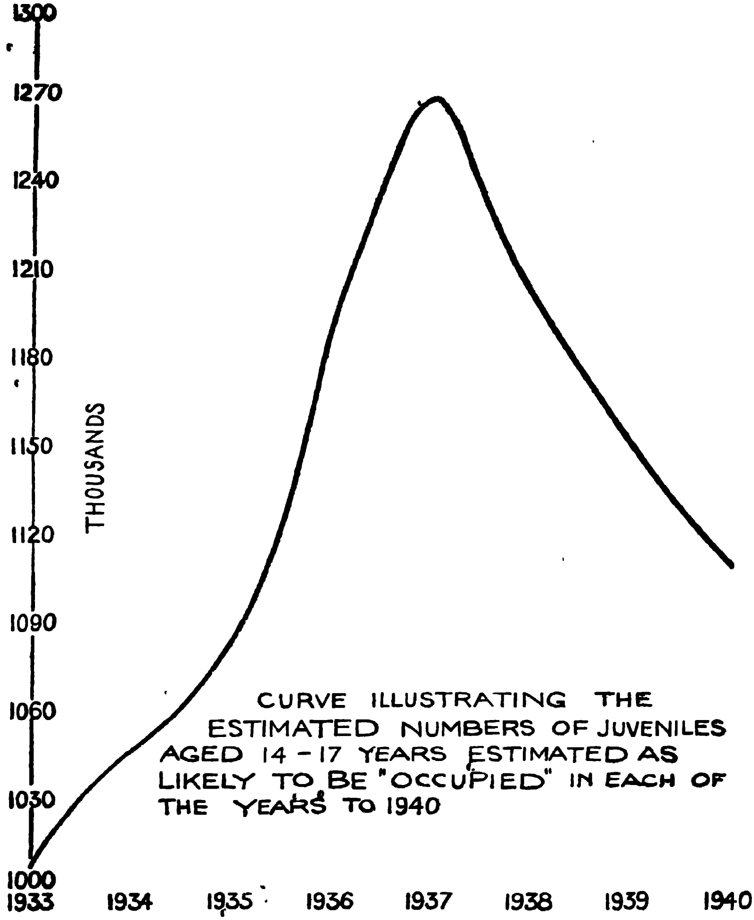
[1] B. F. Shields, *The Evolution of Industrial Organization*, p. 39.
[2] *Factors in Industrial and Commercial Efficiency*, p. 261.

that of supply. The main source of supply is necessarily those boys who have been in casual employment for a year or two after leaving elementary schools and those others who at a later age leave the Technical Intermediate Day Schools to enter industry immediately.

As regards apprenticeship in engineering and kindred industries, the number of entries is less than the number of unskilled juvenile workers, and, as a general rule, apprentices come directly from Technical Intermediate Day Schools and central or secondary schools. It may be noted that in the case of the higher grades of apprenticeships, pupils, and engineering students the source of supply is usually from the universities and technical colleges, and in some cases direct from public schools. In view of the possible revival of all industries and a further decrease in the number of available juveniles resulting from the falling birth rate, it is important to consider all factors which may bear upon a restricted recruitment.

According to the *Committee on Industry and Trade* the absence of the necessary statistics makes it difficult to determine how far the present supply of apprentices in the various industries will ensure a sufficient number of skilled workers in the future, or whether industry in the period of boom will find a shortage of journeymen to be a serious handicap. The accompanying graph (Fig. 41) shows the number of youths from 14 to 17 years of age likely to be occupied in each year to 1940. The curve was plotted from the figures prepared for the Committee on Industry and Trade by the Ministry of Labour in consultation with the Registrars-General of England, Wales, and Scotland.[1] In the description "likely to be occupied" it may be taken that in Great Britain the ratio of apprenticed juveniles to those non-apprenticed is 1 to 7. Hence industry, assuming that a likely shortage of skilled workers is realized in time, will have to find some way to meet the problem of a scarcity

[1] Committee on Industry and Trade, *Factors in Industrial and Commercial Efficiency*, p. 150.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1933
1934
1935
1936
1937
1938
1939
1940

FIG. 41

in the supply of juveniles rather than a particular scarcity of apprentices.

The total number of youths in Great Britain who leave school annually at the average age of 14 years is about 320,000. Roughly one-quarter of this number takes a place in industry which provides some form of systematic training. Of the remaining three-quarters a large number go into agricultural pursuits or directly enter commercial, transport, or distributive employment. Others proceed to receive higher education preparing for non-industrial occupations; some look for unskilled or casual work in the heavy industries such as chemicals, mining, and other branches, which offer very limited opportunities for promotion to skilled or semi-skilled employment.

Much of the human wastage and the evils of a high labour turnover in industry are due to the fact that boys leaving school do not know the opportunities offered by local firms; hence they drift into jobs in a haphazard manner, either by applying at any works or through the medium of the employment office. Increasing attention has been given within recent years to the practicability of attaining a greater industrial efficiency by utilizing more scientific methods of recruitment, so as to ensure that entrants may, so far as practicable, be trained in the occupations for which they are best fitted. The traditional methods at present used in most industrial works for the purpose of recruiting juvenile workers may be noted.

Upgrading or promoting boys who are in casual employment or engaged as operatives in the firm, to the status of trade apprentices, is a method of recruiting apprentices. Some firms rely on the local employment bureau, through which almost the whole output of Technical Intermediate Day Schools or Day Continuation Schools may be absorbed into industry. In the former type of school the preparatory education is suitable, as it generally possesses a distinct engineering bias. Much remains to be done, however, towards developing a greater co-operation between the

technical schools and industrial enterprises, especially with regard to the education of youths who have left school but have not entered skilled employment.

In general, the final selection of applicants for apprenticeships is left to the foreman concerned, who, after a brief interview, obtains assurance as regards the physique and suitability of the youths presenting themselves. Priority of selection is given to sons of employees, to those of whom the foreman has personal knowledge, or to those recommended by their workers or other reliable persons. Larger firms maintain special apprentice supervisors or welfare officers; and with respect to the charging of officials exclusively with the duties of looking after the apprenticeship and learnership problems in the firm, there is a decided tendency throughout an increasing area of industry to substitute for the traditional method of selecting a more scientific system.

The problem may be approached in one of two ways—

1. By guidance of the juveniles as to their future occupation before they leave school.

2. By scientifically testing applicants for employment before allowing them to enter particular employments.

The subject of guidance in choice of employment, or vocational guidance, has received the attention of the Industrial Health Research Board, who within recent years have made many special studies of the questions arising therefrom. The National Institute of Industrial Psychology has also done much research work on this subject from the point of view of the influence of defective recruitment on industrial efficiency as affected by psychological factors. An indication of the nature of the work done to improve industrial efficiency by this Institute may be given by the fact that its investigations in labour efficiency include reference to the following factors—

1. The recruitment and training of labour and other staff.
2. The length and distribution of hours of labour.
3. The elimination of waste of human effort.

Many firms utilize, by means of the Personnel Department, a system of testing and investigation into the capacities required for certain occupations. The care taken in the selection of applicants has proved to be of great benefit later on, not only to the interests of the firm but to the interests of the young workers themselves. An adequate and efficient Personnel department can, in addition to preventing maladjustment of worker and job, encourage a feeling of intimate contact between the management and the employees.

Scientific Research

The scientific faculties of the universities constitute, to a great extent, the world's laboratories for technical research. Industrial progress depends largely on the acquisition and application of fresh fields of knowledge to commercial uses. With the increasing complexity of modern industrial problems, and the necessity of greater technical specialization, it soon became apparent that the State should assist a national movement to promote scientific research in industry. The war emphasized this necessity, since British industries had fallen behind Germany in the application of science to industry and to the development of new products and improved processes of production. The Department of Scientific and Industrial Research was established in December, 1916, as a consequence; and it has gradually developed into a powerful factor in the restoration of industrial prosperity. It will be noted, however, that the advantages offered by the department for the conduct of research are not sufficiently realized. The research movement has not yet secured either the degree or range of support necessary to place British industry as far ahead of other nations in the systematic application of science to business as they might or ought to be.

When the Government Scheme for the promotion of research was introduced it was realized that without the

assistance of the universities the movement in favour of scientific research would suffer a severe check. Government grants have been given to train young graduates in research amounting to about £30,000 annually. Research work of professors and other teachers has been encouraged by the award of grants of £12,000 per year.

To deal adequately with the services rendered by scientific research to industry and trade would require a volume of encyclopædic dimensions. A striking illustration of the results of scientific investigations of this century is the fact that practically no natural product is now exempt from the possibility of a synthetic rival; hence raw materials, which hitherto possessed complete monopolistic control over certain industrial markets, have been faced with an ever-increasing competition from synthetic products.[1] The operations of industry tend more and more to be based on the systematic application of scientific methods and on the enlargement of the boundaries of scientific knowledge with regard to basic principles. This has become the essential factor in industrial efficiency. Research may be considered the great "economic weapon in the conservation of materials and forces and the development of markets."[2]

Research now covers practically the entire field of industrial and technical problems. It is the basis of all development in science. Limits may be set to research work in the distinction drawn between the importance of pure and applied research. It is impossible to say which of the two is of the greater value. Pure research results in new facts and scientific laws; applied research utilizes scientific knowledge for some industrial and commercial end. The distinction is sometimes emphasized by defining pure scientific research as that carried out by the universities, and applied research as that carried out in large industries.

[1] B. F. Shields, *The Evolution of Industrial Organization*, p. 39.
[2] T. H. Burnham, *Engineering Economics*, p. 358.

In effect the greater part of the work done in applied research in industrial undertakings is absorbed by routine testing and the discovery of methods of obtaining improved results from given processes, rather than by the search for new products or processes or investigation of fundamental laws.

The latter order of work is usually beyond the financial resources of individual establishments, and the fact that the entire expense of protracted research may be incurred without any certainty that the establishment will derive any immediate benefit, is often the deciding factor against its adoption.

The measures adopted by the British Government for the encouragement of scientific and industrial research of a kind beyond the means of single firms may be divided, broadly, into two main methods—

"1. The maintenance of central laboratories and research stations controlled and financed by the State for the elucidation of fundamental problems of general industrial interest, e.g. the National Physical Laboratory, the Chemical Research Laboratory, the Fuel Research Station, and the organizations for research into such subjects as food, building, and forest products;

"2. The promotion of Research Associations, i.e. Co-operative organizations for scientific research in connection with particular industries, organized by the industries themselves in accordance with a general scheme, and financed at the outset partly by the industry concerned and partly by the State." [1]

Many outstanding benefits to the general public have followed the work of research associations. For example, definitely measurable financial gain has resulted from research on the heating of buried cables. This work was done for the British Electrical and Allied Industries Research Association at the National Physical Laboratory, and represents an annual saving to the supply industries

[1] *Factors in Industrial and Commercial Efficiency*, p. 37.

of approximately £300,000. If the whole of the electrical industry took full advantage of the efforts of the Electrical Research Association the annual benefit accruing would be, according to estimates, over £1,000,000.

Governmental research on die castings had yielded in 1926 results which represented to one industry alone a value of £100 per month. The industry in question had utilized only a few of the results of the research.

The Woollen and Worsted Research Association suggested one modification in scouring processes which effected an annual saving of over £2000 to one firm and over £1000 to another.

The Linen Research Association, in fostering the development of new strains of pedigree seed, produced a pure strain of flax which gave an increase in the yield of fibre amounting to 25 per cent.

It would be impossible to enumerate the outstanding benefits conferred by scientific research on engineering industries. They include results not only from the work done by the big engineering firms in their own research laboratories but results from co-operative research carried out by associations such as the British Iron Manufacturers' Research Association, the British Non-Ferrous Metals Research Association, and many others. The Institution of Mechanical Engineers furthers research through the medium of Committees, and brings together the best brains in the industry and in the scientific faculties of the universities for the purpose of systematizing scientific investigation of important engineering problems. The results are made available for the whole of the industry.

"It has been stated that the amount spent annually in the United States on industrial research for which authentic data are available is approximately 75,000,000 dollars.[1] While another authority places the amount expended by

[1] Maurice Holland, *Industrial Research in the United States* (published by the Masaryk Academy—Institute for Industrial Management, Prague) (*vide Factors in Industrial and Commercial Efficiency*, p. 318).

American manufacturers in laboratory research alone at 35,000,000 dollars."[1]

[1] *Co-operative Industrial Research* (published by Department of Manufacture, Chamber of Commerce, U.S.A., Washington) (*vide ibid.*)

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